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Recruiting, training, and reenlistment bonus costs are calculated for recruits with 4-year enlistments in 28 rating groups. A computer simulation model is developed to minimize the sum of these costs while meeting manpower requirements at career-entry point LOS-5.

Significant net savings in recruiting and training costs are demonstrated from a policy of targeting higher reenlistment bonuses to ratings with high training costs.

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CNS 1176 / September 1982

BALANCING ACCESSION AND RETENTION

(Final Report of Navy Comprehensive Compensation Study)

Deborah Clay-Mendez
Ellen Balis
Kurt A. Driscoll
Bruce N. Angier
Robert F. Lockman

CENTER FOR NAVAL ANALYSES

UNLIMITED

DEPARTMENT OF THE NAVY
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1. The Center for Naval Analyses was requested to examine the policy alternatives affecting manpower management as a whole to provide a comprehensive strategy for acquiring and maintaining the prescribed enlisted force. Specifically, the tasks were to assess the impact and trade-offs in recruiting, assignment policies, sea-shore rotation, retention, and compensation.

2. The study found that a significant net savings in recruiting and training costs was achievable by targeting higher reenlistment bonuses to ratings with high training costs. The NACCS Study has provided the Navy a substantial argument in support of our current bonus program and the need to firmly establish reenlistment bonuses in our overall compensation program.

3. Enclosure (1) is forwarded.

C. Arth Trost
C. A. H. TROST
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CNS 1176 / September 1982

BALANCING ACCESSION AND RETENTION

(Final Report of Navy Comprehensive Compensation Study)

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Bruce N. Angier
Robert F. Lockman

Enclosure (1) to CNO ltr ser 3U334533 dated 29 April 1983.

Naval Studies Group

CENTER FOR NAVAL ANALYSES

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ABSTRACT

Recruiting, training, and reenlistment bonus costs are calculated for recruits with 4-year enlistments in 28 rating groups. A computer simulation model is developed to minimize the sum of these costs while meeting manpower requirements at career-entry point LOS-5.

Significant net savings in recruiting and training costs are demonstrated from a policy of targeting higher reenlistment bonuses to ratings with high training costs.

EXECUTIVE SUMMARY

Reducing the shortage of career petty officers is one of the Navy's biggest manpower problems. It is especially challenging in the expanding fleet.

The Navy can develop a larger career force either by training more recruits, so more people get to the point of making a career decision, or by retaining a larger fraction of those who get to that point. The former strategy involves higher recruiting and training costs, the latter requires larger expenditures on bonuses.

This study examines the balance between the two strategies. The objective is to find the mix of accession and retention policies that meet the Navy's growing career force requirements at least cost. The findings are conclusive: a policy of higher first-term reenlistment bonuses and smaller cohorts of recruits would enable the Navy to meet its requirements for second-term personnel at lower cost.

The study results are derived using a simulation model that calculates the manpower costs and flows associated with meeting LOS-5 requirements for 4-year obligors under alternative bonus policies. Alternative bonus policies are evaluated for maintaining current (1981) LOS-5 inventories and also for meeting the larger POM 83 Objective Force requirements (FY 1985 goals) for LOS-5. Requirements were specified for 28 rating groups covering 65 Navy ratings and 4 recruit quality types based on education levels and AFQT scores. Recruiting, training, and reenlistment bonus costs are calculated for these groups. Although the analysis is limited to males with 4-year active duty obligations, the basic findings should apply to other groups.

Our three principal findings are:

1. The current Navy SRB program is cost-effective.

   - On the average, each dollar in the current program allows a 2.5 dollar savings in the recruiting and training costs necessary to maintain current LOS-5 inventories.

   - With current LOS-5 inventories, the present discounted cost of a shift from the current bonus program to a "no bonus" program is $600 million.

   - Because the Navy's bonus policy is targeted toward technical ratings with high training costs, the current SRB program is more effective in reducing

training costs than an equal-budget general reenlistment bonus program.

2. Current (FY 81) bonus levels are below their optimum; an expanded bonus program would lead to greater savings.

   - Our most conservative estimate, based on the costs of meeting current LOS-5 inventories, is that a $30 million annual increase in SRB funds would allow a $52 million reduction in recruiting and training costs. The present discounted value of expanding the program in this way is $307 million.

   - If the costs of meeting the POM 83 Objective Force requirements are considered, a $120 million increase in the annual SRB program will allow a $244 million annual decrease in recruiting and training costs. The present discounted savings from the SRB increase would exceed $600 million in the first 3 years.

3. Optimal reenlistment bonus multiples exceed 6 in many ratings.

   - All of the technical ratings in our study have optimal bonus multiples greater than 6.

   - Restricting bonus multiples to a maximum of 6 is particularly costly when an effort is made to meet objective force levels.

In view of these findings, we recommend that the Navy continue its strong support of the SRB program and seek additional funding. The long-run focus of the SRB program should continue to be on the most technical ratings with the highest training costs. The Navy should also try to raise the maximum bonus level above 6, particularly for the technical ratings.

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BACKGROUND

Recent studies deal with the supply of recruits to the Navy, a vital issue in view of the declining size of the youth cohort [1, 2]. Others deal with the responsiveness of first-term enlistees to reenlistment bonuses, an important issue given the shortage of career petty officers and the goal of an expanded Navy [3]. However, the possibilities of trade-offs between accession and retention have received little attention.

In the long run, the Navy can meet requirements for any rating by training fewer recruits and retaining a larger percentage of them, or by training more recruits and retaining a smaller percentage. In this study, we examine the balance between accession and first-term retention in a period of increasing career-force requirements. Our objective is to identify the mix of accession and retention policies that meet career-force requirements at least cost.

Our principal finding is that a policy of higher first-term reenlistment bonuses and smaller cohorts of recruits would enable the Navy to meet its requirements for second-term personnel at lower cost. The Navy realizes the greatest savings if this policy is targeted at ratings where training costs are high.

Due to data constraints, our analysis is restricted to non-prior service (NPS) males with 4-year active duty obligations. However, we believe that our qualitative findings would be unchanged if the study were extended to 3-year and 6-year obligors.

We address three policy questions:

1. How might the Navy have achieved its current LOS-5 inventory at less cost?

2. How valuable are rating-specific reenlistment bonuses as opposed to general reenlistment bonuses in balancing accession and retention?

3. How can the Navy achieve the POM 83 Objective Force levels for the fifth year of service (LOS-5) at least cost? (The POM 1983 Objective Force specifies goals for the Navy to reach by FY 1985.)

We realize that the Navy's main concern is how to achieve a larger force at least cost, not how it might have achieved its current level of manning at less cost. But an analysis using current force levels provides a useful benchmark for comparison. In addition, discussion of the objective force requires us to project the impact of policies far beyond their observed range. Thus, while we find that higher bonuses are

desirable for either maintaining the current force or for achieving a larger force, our strongest evidence for this comes from analyzing alternative policies for the current force.

THE MODEL

This section contains an overview of the model that we developed to analyze the trade-offs between accession and retention. A complete algebraic description is provided in appendix A.

The model has two parallel components. First, it simulates the flow of recruits from recruiting through the first-term reenlistment decision to length of service cell 5 (LOS-5). Second, it estimates the costs of recruiting, recruit training, A-school training,* and the reenlistment bonuses associated with the recruit flow.

Both the recruit flows and the cost estimates are disaggregated by rating group and recruit quality type. The 28 different rating groups cover 65 Navy ratings with sizeable numbers of 4-year obligors; recruits assigned as general detail personnel (Gendets) are treated as one of these rating groups. A table listing these rating groups is included in appendix B. The four recruit quality types considered are combinations of educational attainment and AFQT mental groups: HSDG 1-3U, HSDG 3L-4, NHSDG 1-3U, and NHSDG 3L-4.**

The policies varied by the Navy within the model include the number of accessions of each quality type, the proportion of each quality type initially assigned to the different A-schools or to Apprenticeship training, and the level of the first-term reenlistment bonus for each rating group. By controlling these policies, the Navy determines the flow of recruits from enlistment through first-term reenlistment.

RECRUIT FLOWS

A simplified view of the recruit flow for one quality type is shown in figure 1. The feathered arrows mark the three points--recruiting, training assignment, and reenlistment--where the Navy's policies control the flow. The solid arrows correspond to transition probabilities that are fixed in the model. These probabilities are calculated for each quality type and rating group using the 1980 and 1981 Enlisted Master Records. The data used are described in appendix C.

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* An A-school consists of a series of courses designed to train a recruit for a specific occupation (Navy rating). Following recruit training, recruits are assigned either to an A-school or--if they are destined to do general detail work (GenDet)--to a brief apprenticeship training program.

** HSDG refers to high school diploma graduates; NHSDG refers to individuals without high school diplomas.

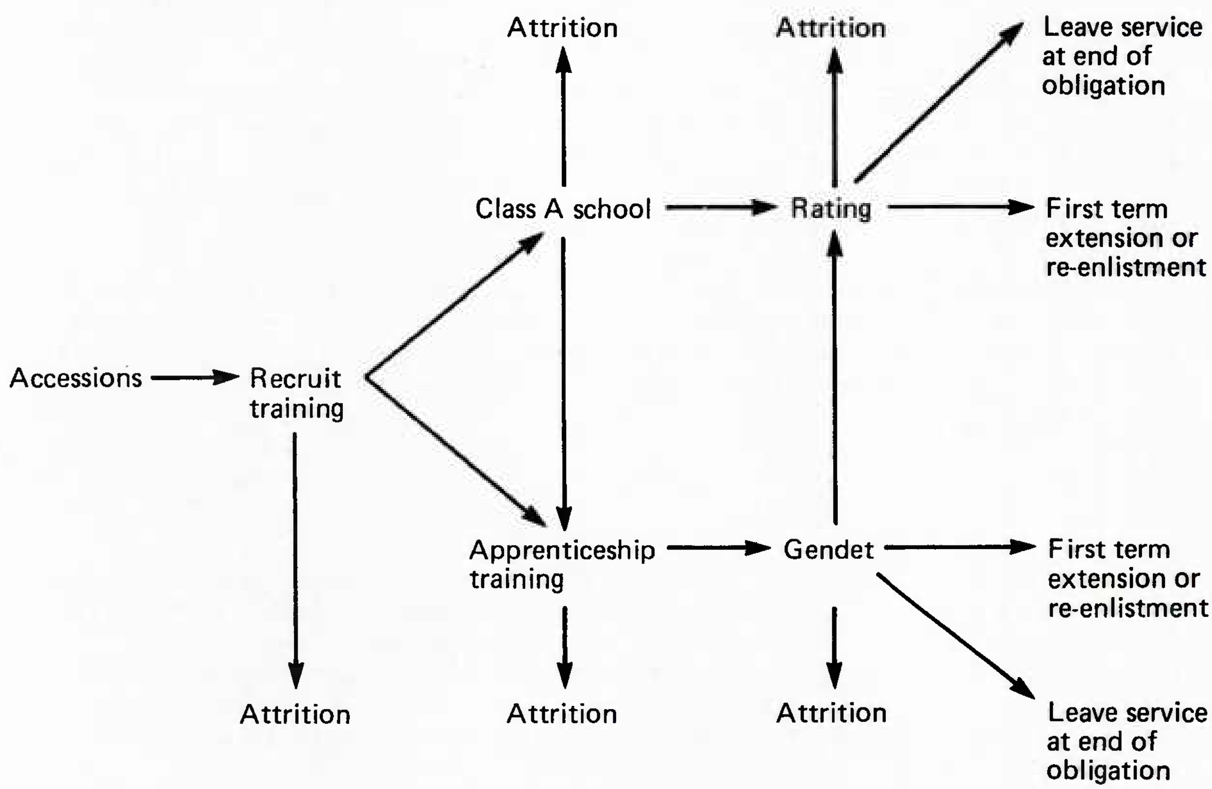

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FIG. 1: FLOW FOR GIVEN QUALITY TYPE

Consistent with previous CNA research [3], we incorporate a positive relationship (approximated by a logistic function), between the first-term reenlistment rate in each rating group and the level of the reenlistment bonus for the group. The Navy controls reenlistment rates by varying bonus levels. Estimates of the bonus effects for the different rating groups were available based on earlier work done at CNA [4]. Our modification of these estimates for use in the current model is summarized in appendix E. No estimate of the bonus effect was available for general detail personnel (Gendets), so we constrained their reenlistment bonus to zero.

Individuals who become Gendets after failing A-school, or who are initially assigned as Gendets, can eventually qualify for a rating through on-the-job training or by returning to A-school. This leads to interactions between the policies for one rating and the recruit flow into other ratings. There is some probability that individuals of a given quality type who are initially assigned to training for rating X will emerge at LOS-4 (length of service cell 4) eligible to reenlist in rating Y.* To handle this issue, we constructed a 28 x 28 matrix of historical probabilities for each recruit quality type. These matrices allow us to relate the Navy's initial training assignments to the number of eligibles in each rating group and quality type.

COSTS

Each possible set of recruiting, training assignment, and reenlistment bonus policies involves different costs as well as different recruit flows. The second component in our model is the estimation of these costs. All costs are calculated in 1982 dollars and discounted at a 10 percent annual rate unless otherwise noted; appendix C describes the data used.

We derived our estimates of recruiting costs for HSDGs from a model of recruit supply developed earlier at CNA [1]. This supply model predicts numbers of male, high-school graduate Navy recruits based on levels of Navy advertising, numbers of recruiters, the level of military compensation, and other economic and demographic factors. Using estimates of the cost of Navy recruiters and advertising, we transformed this supply equation into a cost function that specifies the minimum cost of obtaining different numbers of male, high school diploma graduates with 4-year obligations. This transformation is described in appendix D and reference [5]. At current recruiting levels, we estimate that the marginal cost of recruiting a HSDG is $4,300. An important characteristic of our cost function, however, is that the cost of recruiting additional HSDGs increases as more are recruited.

* The calculation of these probabilities for each quality type is described in appendix F.

Estimates of the cost of recruiting non-graduates are not available. In applying the model, sensitivity analysis can be used to deal with this issue. We were, however, able to estimate the costs of AFEES* processing. This cost is higher for non-HSDG recruits ($330) than it is for HSDG recruits ($120), because a smaller proportion of the non-HSDG applicants qualify for enlistment.

The costs of recruit training, A-school training for the different rating groups, and apprenticeship training were calculated using long-run average cost data provided by the Chief of Naval Education and Training (CNET). These calculations are described in [6]. In this data base, the cost of training recruits varies by recruit quality type only because of differences in attrition rates. Since possible differences in the difficulty of training recruits are not taken into account, the cost advantage of recruits in the upper mental groups may be understated. Table 1 shows recruit training costs and the mean A-school costs for technical, semi-technical, and non-technical rating groups by recruit quality type.**

TABLE 1

TRAINING COSTS BY RECRUIT QUALITY TYPE
(1982 Dollars)

Recruit quality type	Recruit training costs	A-School costs: Nontechnical	A-School costs: Semi-technical	A-School costs: Technical
HSDG I-IIIU	$2,800	$4,900	$7,200	$12,200
HSDG IIIL-IV	2,800	5,000	7,500	12,900
NHSDG I-IIIU	2,900	5,200	8,100	13,300
NHSDG IIIL-IV	2,900	5,400	9,200	14,500

Reenlistment bonus costs are calculated in a straightforward manner under the assumption that all reenlistments are for 4 years. Approximately 26 percent of those who reach the fifth year of service in the model do so by extending their first term for less than 3 years. They are not eligible for bonus payments (about 40 percent extend initially, but some of them later reenlist).

Two elements of compensation are not included in the model. Retirement costs are excluded, because they are largely a function of the size of the career force. They do not have to be considered

* Armed Forces Examining and Entrance Stations.
** Each of the 28 rating groups is identified as technical, semi-technical, or non-technical in accordance with table B-1, appendix B.

explicitly when comparing alternative ways of meeting fixed LOS-5 requirements. Compensation paid to first-term personnel not in training is also excluded under the assumption that the pay of first-term personnel is offset by their productivity.* In this case, the Navy will benefit from raising first-term reenlistment bonuses if the cost of the highest bonus is offset by the savings in recuiting and training costs that result. If pay or some portion of it were counted as a cost, it would raise optimal bonus levels and strengthen our findings.

REQUIREMENTS

While our aggregate model can simulate the flow of recruits and the associated costs for any set of recruiting, assignment, and reenlistment bonus policies, we are mainly concerned with policies that enable the Navy to meet its requirements for individuals starting their second term of service (LOS-5). Because the model views incoming recruits chiefly as a means for meeting career force goals, it is most appropriate when applied to situations where the size of the career force, rather than the level of first-term manpower, is the major concern.

We considered two different sets of requirements. The first is based on observed levels of manning in September 1981. All males in their fifth year of service who had enlisted as non-prior service, four-year obligors were identified on the basis of quality type and rating group. In the aggregate, this yields a requirement for 9,400 individuals at LOS-5.

The second set of requirements for male, 4-year obligors is derived from the Navy's POM 83 Objective Force requirements for LOS-5. We constructed a requirement for male, 4-year obligors based on the Navy's objective force requirement and the current ratio of male, 4-year obligors to LOS-5 inventory in each rating. This procedure is described in detail in [7]. The resulting objective force requirement was 13,200. This is 39 percent greater than the observed force. It can be viewed as a goal for the Navy to reach by 1985.

For a given set of requirements, lower reenlistment bonuses imply lower retention rates and an increase in the steady-state size of incoming recruit cohorts. Using our model, we were able to estimate the recruit flows and manpower costs involved in meeting both current force levels and objective force levels under alternative reenlistment bonus

* Compensation paid while in training is included as a cost.

policies.* The results of this investigation into the balance between accession and retention are presented next.

* This was done by working backwards from each set of requirements. A reenlistment bonus policy--consisting of a vector of 28 reenlistment bonus levels--is selected. Given this policy, the requirements for second-term individuals of a specific quality type in each rating group determines the number of eligibles at LOS-4 required in that group. The product of this vector of eligibles and the inverse of the 28 x 28 probability matrix for that quality type is an initial assignment vector. The sum of the elements in the assignment vector is the total number of recruits of that quality type required. For each possible bonus policy, there is a recruiting and an assignment policy consistent with meeting second-term requirements.

POLICY ANALYSIS

CURRENT FORCE

In this section, we examine the costs of meeting current LOS-5 inventories under alternative bonus policies. We start by calculating the costs under current bonus policies. These costs are compared to the costs which would be incurred in meeting current inventories in the absence of a reenlistment bonus program. Finally, we examine an optimal set of bonus policies--a set that minimizes the costs incurred in maintaining current force levels. In doing so, we answer the question, "How might the Navy have balanced accession and retention to achieve its current LOS-5 inventory of 4-year obligors at least cost?"

Current Force Under Current Bonus Policies

We established a base case reflecting the steady-state costs of current policies by working backwards from the current force using actual 1981 bonus policies. Given the current force and 1981 bonus levels, we calculated the number in each rating group and quality type who must have been eligible at LOS-4. We then used the recruit flows described earlier to determine what the initial training assignment policies and accessions policies had to be to yield this number of eligibles.

We find that 52 thousand non-prior service, male, 4-year obligor recruits were required, 70 percent of whom were high school diploma graduates (see table 2). At LOS-4, 33 thousand of these recruits were eligible to reenlist. Under the 1981 bonus policies,* the continuation rate (extensions plus reenlistments) from year 4 to year 5 was 29 percent, so that estimated inventory at year 5 matches the current force number of 9,400. It also matches the distribution of this inventory by quality type and rating group.

These recruit flows are based on the attrition rates prevailing between 1980 and 1981. The size of the recruit cohort in this base case represents the number of recruits that would have to be recruited now--given current attrition patterns--to maintain current LOS-5 manning in a steady state.

Note that reenlistment bonus payments account for 6 percent of annual costs. If we discount costs incurred later in the enlistment using a 10 percent annual rate, bonus payments account for 4 percent of

* Table G-1 in appendix G lists the 1981 bonus multiples for the 28 rating groups. Where bonus multiples differed among the ratings within a single rating group, a weighted average was used.

the present-discounted cost of a cohort. The average present-discounted cost for each individual required at LOS-5 is $52 thousand.

TABLE 2

ANNUAL STEADY-STATE VALUES
UNDER CURRENT POLICIES

	Annual costs	Percent of total
Recruiting and AFEES costs	$104M	21%
Recruit training	130M	26%
A-school and apprenticeship training	241M	48%
Reenlistment bonus payments	32M	6%
	$507M	100%
Number of recruits	52K	
Number at LOS-4 eligible to reenlist	33K	

Matching the Current Force in the Absence of Selected Reenlistment Bonuses

If the current first-term reenlistment bonus program were to be eliminated for male, four-year obligors, the LOS-4 to LOS-5 continuation rate for this group would fall by approximately 3 percentage points. Additional eligibles and hence additional recruits would be needed to meet the current force requirement.

The annual, steady-state costs of matching the current force in the absence of reenlistment bonuses are presented below. They are $48 million greater than steady-state costs under the current bonus program. On the average, each dollar allocated to Zone A Selective Reenlistment Bonus (SRB) payments allows 2.5 dollars to be saved in recruiting and training costs.

$555M is the annual recruiting and training cost given the 59K annual accessions shown in table 3. Yet the number at LOS-4 eligible to reenlist is not affected by the increased annual accession rate until year 4. If LOS-5 inventories are to be maintained, SRB payments cannot be eliminated until year 4.

Yet this steady-state comparison actually understates the savings from maintaining the current SRB program. If the Navy tried to eliminate the SRB program while continuing to match current LOS-5 inventories, it would have to raise recruiting, recruit training, and A-school flows approximately 4 years <u>before</u> it could lower Selective

Reenlistment Bonus payments. The present discounted cost of this policy change is calculated by making the following comparisons:

	Year 1	Year 2	Year 3	Year 4 and onward
New policy	$555M +32M $587M	$555M +32M $587M	$555M +32M $587M	$555M
Current policy	$507M[a]	$507M	$507M	$507M
Cost of transition	$+80M	$+80M	$+80M	$+48M

[a]From table 2.

TABLE 3

MATCHING THE CURRENT FORCE IN THE ABSENCE OF FIRST-TERM BONUSES

	Annual costs	Change from current policy (1981)
Recruiting and AFEES processing costs	$128M	$+24M
Recruit training costs	147M	+17M
A-school and apprenticeship training costs	280M	+39M
Reenlistment bonus costs	0M	-32M
	$555M	$+48M
Number of recruits	59K	+7K
Number at LOS-4 eligible to reenlist	37K	+4K

Based on a 10 percent annual discount rate, the Navy would lose approximately $600 million present-discounted dollars by eliminating the reenlistment bonus program for male, four-year obligors. If the discount rate is 3 percent, the present-discounted loss is approximately $1,700 million.

Current Force Under Optimal Bonus Policies

Our next step was to search for the set of reenlistment bonuses that minimizes the cost of maintaining the current force. Not all possibilities could be investigated, but we have identified a set of

policies that appears to be very close to the optimal set.* Simulations using bonus multiples that are either higher or lower than our solution result in higher costs.

The median value for different types of rating groups under this "approximate" optimal policy are shown in table 4.** Optimal bonus multiples were greater than or equal to current levels in all rating groups. The highest multiples--and the greatest discrepancy between current and optimal levels--are found in the most technical ratings with the highest training costs. Other factors associated with high optimal reenlistment bonus levels include high first-term attrition and a low reenlistment rate in the absence of bonuses.***

TABLE 4

MEDIAN BONUS MULTIPLES UNDER ALTERNATIVE POLICIES

	Current policy	Optimal policy	Constrained optimal policy
Technical ratings	3	14	6
Semi-technical ratings	0	8	2
Non-technical ratings	1	5	2

The median value for the optimal bonus level in the technical rating groups was 14. There are two problems with bonus multiples at that level. First, we cannot project the impact of bonus levels that are so far removed from observed values. Second, even if it is the best policy, it is politically unrealistic.

Consequently, we investigated the costs associated with the constrained optimal policy summarized in column 3 of Table 4.**** This is the approximate optimal policy constrained so that: the maximum bonus multiple in any rating group is 6; and the maximum increase in the reenlistment rate for any group is 15 percent. The second constraint was introduced because a percentage increase in the reenlistment rate

* The search procedure which we used to approximate an optimal solution is described in detail in [8].

** The specific multiples for each of the 28 rating groups are shown in appendix G, table G-1.

*** See [9] for a theoretical discussion. This last factor may account for the high optimal bonus levels that we found for two non-technical ratings (BTs and HTs) that frequently involve unpleasant work.

**** The bonus multiples for each of the 28 rating groups are shown in appendix G, table G-1.

when LOS-5 inventories are held constant implies a decline in manning in LOS cells 1 through 4 of approximately the same percentage.

The annual steady-state costs associated with the constrained optimum are shown in table 5. In the steady state, a $30 million increase in reenlistment bonus payments brings a $52 million savings in recruiting and training costs. This $30 million represents a 94 percent increase in Zone A bonus payments for 4-year obligors.

TABLE 5

ANNUAL STEADY-STATE VALUES
UNDER THE CONSTRAINED OPTIMAL POLICY

	Annual costs	Change from current policy (1981)
Recruiting and AFEES processing costs	$ 88M	$-16M
Recruit training costs	118M	-12M
A-school and apprenticeship training costs	217M	-24M
Reenlistment bonus costs	62M	+30M
	$485M	$-22M
Number of recruits	47K	-5K
Number at LOS-4 eligible to reenlist	29K	-4K

This steady-state comparison actually understates the gains from increased bonus levels, however, since the $30 million increase in bonus costs does not occur until 4 years after the decrease in training and recruiting costs. Table 6 shows that savings are approximately $52 million in years 1, 2, and 3. The total present discounted value of a shift from current policy is $307 million, based on a 10-percent discount rate. $307 million is 36 percent of the savings that would be offered by the unconstrained optimal policy.

Our model minimizes costs for fixed LOS-5 requirements. But these findings also mean that a larger LOS-5 force might be purchased for the same cost.

Current Force with a General First-Term Reenlistment Bonus

A general first-term reenlistment bonus would raise reenlistment rates and allow the Navy to meet LOS-5 requirements with a smaller

investment in recruiting and training.* How much of the savings from selective bonus payments is due to the targeted nature of these payments? How much is due to their general impact on second-term compensation?

TABLE 6

SAVINGS FROM CHANGE TO CONSTRAINED OPTIMAL POLICIES

	Year 1	Year 2	Year 3	Year 4 and onward
Constrained optimal policy	$455M	$455M	$455M	$485M
Current policy	507M	507M	507M	507M
Savings from transition	52M	52M	52M	22M

To answer these questions, we calculated the costs of maintaining current LOS-5 inventories with general, as opposed to rating-specific, first-term reenlistment bonuses.

We took bonus costs under current long-run Navy policy and calculated the general first-term reenlistment bonus that would require the same SRB budget. The long-run bonus multiple for each rating was the average multiple for the period 1974 to 1982. Use of these average multiples reduces the influence of short-run fluctuations in bonus levels made necessary by unexpected changes in training flows or requirements.

Annual Zone A bonus payments for 4-year obligors under current long-run policy amount to $38 million per year. For the same budget, we found that the Navy could offer a first-term reenlistment bonus with a multiple of 1.85 to all 4-year obligors.

Table 7 compares the annual recruiting and training costs required to maintain LOS-5 manning under the current long-run policy with the same costs under an equal-budget general reenlistment bonus. It illustrates the advantage of the current bonus targeting system. In a steady

* Our theoretical work [9] highlights the trade-off between general compensation and reenlistment bonuses by showing that the optimal value of the reenlistment bonus is inversely related to the difference between military and civilian pay. We were able to confirm this result using our empirical model.

state, the Navy saves $12 million annually by using targeted bonuses as opposed to general reenlistment bonuses. The $12 million is 20 percent of the total savings from the Navy's long-run bonus policy (relative to a policy of no reenlistment bonuses).

TABLE 7

COST OF MAINTAINING CURRENT LOS-5 INVENTORY:
CURRENT LONG-RUN POLICY VS. UNTARGETED MULTIPLE

	Current long-run policy	Equal cost untargeted multiple (1.85)	Savings from targeted bonuses
Recruiting and AFEES costs	$ 99M	$101M	$2M
Recruit training	127M	128M	1M
A-school and apprenticeship training	233M	242M	9M
Reenlistment bonus payments	38M	38M	0M
	$497M	$509M	$12M

Most of the savings comes from A-school rather than recruiting or recruit training costs. This is because current long-run policy targets reenlistment bonuses toward rating groups where training costs and the value of reenlistments are high.

Under the long-run policy, the median bonus is 3.3 for the highly technical ratings, 1.2 for the semi-technical ratings, and 0.9 for the non-technical ratings. Since the Navy is not exceeding its LOS-5 requirements in the technical ratings, this long-run pattern indicates that the Navy has allowed its training flows to adjust downward in these technical ratings. The Navy is depending on continued reenlistment bonuses rather than on training flows alone to meet career force requirements. Reenlistment bonuses are already playing a long-run role in balancing accession and retention, in addition to their short-term role as a tool for adjusting to fluctuations in pipeline flows and requirements.

Eventually, this type of analysis could be used by the Navy to target its existing SRB budget even more effectively. Preliminary work with our model indicates that in the long run it could enable the Navy to save an additional $6 million annually in 4-year obligor recruiting

and training costs. This result, however, is very sensitive to our estimates of rating-specific pay responsiveness.

OBJECTIVE FORCE

Now we turn to the results obtained in trying to match objective force requirements under alternative policies. Development of the career force required for an expanded Navy is one of the most important manpower issues confronting the Navy today. Although the first-term manpower that will eventually be required for the larger force is not currently needed, the Navy must start immediately to "grow" the additional petty officers that will be required. Because our model focuses on the role of first-term manpower as a source for the career force, it is an especially appropriate tool for analysis of this transition.

Objective Force Under Current Bonus Policies

What would happen if we tried to meet LOS-5 objective force requirements using current bonus policies? Table 8 shows that, in moving from the current to the objective force, LOS-5 manning increases by 39 percent while the size of the required incoming recruit cohort increases by 49 percent. The explanation is that the requirements increased disproportionately for rating groups where attrition rates are relatively high and reenlistment rates relatively low. Together with increasing marginal recruiting costs, this explains why a 39 percent increase in LOS-5 requirements increases annual costs by 73 percent.

TABLE 8

STEADY-STATE VALUES FOR OBJECTIVE FORCE REQUIREMENTS
UNDER CURRENT BONUS MULTIPLES

	% Change from levels based on the current force
Recruiting and AFEES costs	108%
Recruit training	49%
A-school and apprenticeship training	70%
Reenlistment bonus payments	78%
Total	73%
Number of recruits	49%
LOS-5 manning	39%

Objective Force Under Alternative Policies

When we looked at alternative policies, we found that many of the optimal bonus multiples for the objective force lie above the range that can be legitimately analyzed. (See appendix G, table G-2.) For all but one rating group (BM and SM), the optimal multiple under the objective force requirement is higher than the optimal multiple calculated for current force requirements. We expected this result.* Unfortunately, our numbers are not very meaningful beyond a multiple of 7 or 8.

We were able to analyze the constrained optimal solutions summarized in columns 3 and 4 of table 9. The policy shown in column 3 represents the least-cost solution we could find without allowing bonus multiples to exceed 6; the policy in column 4 allows multiples up to 8. In the first of these constrained solutions, there is very little opportunity for targeting. The bonus multiple ceiling of 6 is binding in 21 of 27 rating groups. When the ceiling is raised to 8, it is binding in 15 of 27 rating groups, presenting more opportunities for targeting.

TABLE 9

MEDIAN BONUS MULTIPLES UNDER ALTERNATIVE POLICIES FOR OBJECTIVE FORCE

	Current policy	Unconstrained optimal policy	Constrained with maximum bonus level=6	Constrained with maximum bonus level=8
Technical ratings	3	17	6	8
Semi-technical ratings	0	9	6	8
Non-technical ratings	1	6	6	6

The steady-state costs of meeting the LOS-5 objective force under current bonus policies is compared with the same costs under the two constrained policies in table 10. The annual steady-state savings from using the constrained policy with a maximum multiple of 6, as opposed to the current bonus multiple policy, is roughly $124 million. In the first 3 years, use of this higher bonus policy would save the Navy over $600 million present discounted dollars.

* In our theoretical work, we found that higher force requirements implied higher optimal bonus levels [9].

TABLE 10

STEADY STATE VALUES UNDER ALTERNATIVE POLICIES
FOR THE OBJECTIVE FORCE

	Current	Constrained with maximum multiple = 6	Constrained with maximum multiple = 8
Recruiting and AFEES processing	$216M	$124M	105M
Recruit training	194M	146M	133M
A-school and apprenticeship training	194M	305M	269M
Reenlistment bonus	57M	177M	219M
Total	$876M	$752M	$726M

If the ceiling on bonus multiples is raised to 8, an additional $26M in annual steady-state savings is possible. The total present discounted cost of restricting bonuses to a maximum of 6 is $377M.* At current force levels, the ceiling of 6 on bonus multiples is not a very costly constraint. But it does become costly when we are dealing with the objective force.

CONFIRMATION OF GENERAL FINDINGS

It was not practical to calculate the costs associated with all possible combinations of bonus policies for the 28 rating groups in our model. As a result, the optimal bonus policies that we found are only approximations to the true optimal solutions. We were, however, able to develop a more aggregate version of the model based on seven larger groups of ratings [10]. Using this aggregate model, we tested all possible combinations of bonus policies and to confirm the qualitative findings of the less aggregate model. Optimal bonus levels were equal to or greater than current levels for each of the 7 aggregate groups and the highest optimal bonus levels were found in the groups with the highest training costs. In addition, optimal bonus levels increased with the level of requirements.

* This is the difference in savings between moving immediately to the first constrained solution and moving to the second constrained solution.

PROSPECTS

Standing back from our specific findings, we can point to areas where further work is desirable and in progress.

We need to refine our estimates of bonus responsiveness at the rating-specific level. Once this is done, we can actually use this kind of analysis in targeting bonuses for specific ratings. CNA is currently working on this.

The model should be refined so that civilian unemployment levels and relative military-to-civilian pay appear explicitly as variables affecting the accession and retention trade-off.

We also need to develop improved estimates of the impact of Zone A bonus multiples on the second-term reenlistment decision. Bonus-induced reenlistees have lower second-term reenlistment rates than do other second-termers [11]. This could lead us to modify some of our more extreme results.

On a more basic level, we would like to revise this model so that instead of meeting fixed LOS-5 requirements at least cost, it meets a fixed level of effectiveness at least cost. This is the real problem facing the Navy. As a first step in this direction, we are trying to identify the relative productivities of first-term and career personnel in different ratings. Extending our model to encompass other groups--women, 3-year obligors, and 6-year obligors--might also be a long-run goal. Nonetheless, the primary emphasis should be on making the model better before making it bigger.

Notwithstanding the need for such improvements, we believe that the following findings can legitimately be made on the basis of the model as it currently stands:

- Zone A bonus levels are below their optimal values in virtually all rating groups
- Optimal bonus multiples exceed 6 in many rating groups
- The Navy's current bonus policy is more cost-effective than untargeted bonuses

In view of these findings, we recommend an expanded role for reenlistment bonuses. Ideally, this expansion would involve a substantial increase in the SRB budget, preceeded by a planned reduction in training flows. It is clear, however, that reductions in training flows, if not followed by increased bonus payments, would ultimately lead to serious manpower shortages. To make reductions in accessions a viable policy for the Navy, Congress--acknowledging that manning the career force is a

problem in long-term procurement--would have to agree in advance to fund the entire life-cycle costs associated with the smaller recruit cohorts. This may not be a realistic expectation.

On a more practical level, we have seen that the Navy is already using its current SRB budget as a long-run tool for balancing accession and retention among the different ratings. The Navy's ability to do this is limited by the size of the current SRB budget and by the need to use bonuses to compensate for short-term fluctuations in recruit flows and requirements. Nonetheless, we recommend that this use of the SRB program be vigorously pursued as an explicit policy. Taking into account the costs of training in the different ratings, additional emphasis can be placed on the joint determination of training flows and long-run retention goals.

It is important to remember, however, that any additional savings the Navy might achieve by refining its long-run targeting of the current SRB budget are small relative to the savings it could achieve from a larger SRB program. Thus, the Navy's most important task is to fight for an expanded SRB program, reminding Congress that the Navy is already taking in fewer recruits because of reenlistment bonuses, and that the bonus costs are more than offset by savings in recruiting and training dollars.

REFERENCES

[1] CNA Memorandum 82-1158, "Summary of the Navy Enlisted Supply Study," by Lawrence Goldberg, Unclassified, 22 July 1982

[2] "The Impact of Various Types of Advertising Media, Demographics, and Recruiters on Quality Enlistments," Center of Applied Business Research, Graduate School of Business, Duke University, July 1980

[3] CNA Memorandum 79-1878, "An Empirical Analysis of Pay and Navy Enlisted Retention in the AVF," by John T. Warner and Bruce Simon, Unclassified, 21 December 1979

[4] CNA Professional Paper 337, "The Influence of Non-Pecuniary Factors on Labor Supply," by John T. Warner and Matthew S. Goldberg, Unclassified, December 1981

[5] CNA Memorandum 82-0132.10, "Documentation for the Recruiting Cost Estimates Utilized in the Navy Comprehensive Compensation and Supply," by Deborah Clay-Mendez, Unclassified, 30 Sept 1982

[6] CNA Memorandum 82-0497.10, "Construction of Training Cost Per Graduate for the Navy Comprehensive Compensation and Supply Study," by Bruce Angier and Kurt Driscoll, Unclassified, 4 Nov 1982

[7] CNA Memorandum 82-0547.10, "Manpower Requirements Derivation for the Navy Comprehensive Compensation and Supply Study," by Bruce Angier, Kurt Driscoll, and David Gregory, Unclassified, 30 Sept 1982

[8] CNA Memorandum 82-0789.20, "Balancing Accession and Retention: The Disaggregate Model," by Deborah Clay-Mendez and Ellen Balis, 23 Aug 1982

[9] CNA Memorandum 82-1142.10, "Models of Accession and Retention," by Deborah Clay-Mendez, Unclassified, 1 Oct 1982

[10] CNA Memorandum 82-0793.10, "Balancing Accession and Retention: The Aggregate Model," by Ellen Balis and Deborah Clay-Mendez, 26 Jul 1982

[11] Memorandum, (CNA)82-0079, "A Minimum Recruiting Cost Function for Male High School Graduates," by Debbie Clay-Mendez, 19 Jan 1982, Unclassified

[12] CNA Memorandum 81-0916, "A Comparison of the Prophet and ACOL Force Projection Models," by Matthew S. Goldberg and Michael F. Hager, Unclassified, 10 Jun 1981

REFERENCES (Cont'd)

[13] Amemiya, Takeshi, "Qualitative Response Models: A Survey" Journal of Economic Literature, Vol. XIX, No. 4, Dec 1981

APPENDIX A

AN ALGEBRAIC DESCRIPTION OF THE MODEL

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AN ALGEBRAIC DESCRIPTION OF THE MODEL

USE OF THE MODEL

The model that we developed to analyze the trade-off between accession and retention can be used in two ways. First, it can be used to determine the steady-state LOS-5 inventories and costs associated with alternative sets of Navy policies. In this case, the policies which are controlled by the Navy include:

XR_i = the number of recruits of quality type i

P_{ij} = the probability of assigning a type i recruit who has completed recruit training to rating j, and

$BMULT_j$ = the reenlistment bonus multiple for the jth rating.

Second, given a required LOS-5 inventory, the model can be used to calculate the recruit flows (and associated costs) needed to match that inventory under alternative bonus policies ($BMULT_j$s). In this case, the XR_i and P_{ij} are determined by the model; they are the accession and training assignment policies which the Navy must follow in order to match its required inventory under the bonus policy being considered. Our study relies principally on this second use of the model. By searching across alternative sets of $BMULT_j$, we identify the set of bonus policies that minimizes the cost of meeting LOS-5 requirements.

As a starting point, we first present the algebraic equations which enables us, given any set of XR_i, P_{ij}, and $BMULT_j$, to determine the resulting LOS-5 inventories and annual manpower costs. We then show how, given fixed LOS-5 inventories and $BMULT_j$, it is possible to work backwards through the manpower flows to solve for the XR_i and P_{ij}. Each parameter in the model is defined as it initially appears; in addition, a complete list of the parameters is provided in Table A-1. The data used to estimate these parameters are outlined in appendix C.

TABLE A-1

VARIABLES AND PARAMETERS FROM THE NACCS MODEL

Navy Decision Variables

$BMULT_j$	=	the reenlistment bonus multiple for the jth rating
P_{ij}	=	the probability of assigning a type i recruit who completed recruit training to rating i
XR_i	=	the number of recruits of quality type i

Functions of Decision Variables

$BONUS_{ij}$ $(BMULT_j)$	=	the dollar value of the reenlistment bonus to a type i individual in the jth rating
$EXTE_{ij}$ $(BMULT_j)$	=	the probability that a type i individual eligible to reenlist in the jth rating will extend from 1 to 3 years
$REUP_{ij}$ $(BMULT_j)$	=	the probability that a type i individual eligible to reenlist in the jth rating will do so
REC\$ (XR_1+XR_2)	=	recruiting costs (the costs of recruiters and advertising)

Transition and Cost Parameters (Constants)

$ASCHS_{ij}$	=	probability of success in the jth A-school for a type i individual
ASCH\$$_{ij}$	=	cost per A-school graduate of quality type i, jth A-school
$ELIG_{1i}$	=	probability that a rated individual of quality type i in LOS-4 is eligible for reenlistment
$ELIG_{2i}$	=	probability that a Gendet of quality type i in LOS-4 is eligible for reenlistment

TABLE A-1 (Cont'd)

Transition and Cost Parameters (Constants)

$GENCON_{ki}$	=	probability that an individual of the ith quality type who begins year k as a Gendet will complete that year as a Gendet
$GENTOA_{kij}$	=	probability that an individual of quality type i who begins year k as a Gendet will qualify for rating j during year k
$GENUP_i$	=	probability that a reenlistment eligible Gendet of quality type i will reenlist
$GEXTE_i$	=	probability that a reenlistment eligible Gendet of quality type i will extend from 1 to 3 years
$GSEXT_i$	=	the ratio of the number of extensions of less than 1 year to the number of extensions of 1 to 3 years by Gendets of quality type i
$PROC\$_i$	=	the cost of the Armed Forces Entrance Exams and processing for quality type i individuals
$RTCS_i$	=	probability that a quality type i recruit will successfully complete recruit training
$RTC\$_i$	=	cost per recruit training graduate of quality type i
$SEXTE_{ij}$	=	the ratio of the number of extensions of less than 1 year to the number of extensions of 1 to 3 years by individuals of quality type i in rating j
$STAYER_j$	=	probability that an individual who has failed the jth A-school will remain in the Navy as a Gendet
$TERMS_{kij}$	=	probability that an individual of quality type i who begins year k will complete year k

PERSONNEL FLOWS AND LOS-5 INVENTORIES FOR GIVEN XR_i, P_{ij}, AND $BMULT_j$

Overview of Personnel Flow

In the steady state, individuals from within a series of identical cohorts move from the accession point through recruit training, Class A-school or apprenticeship training, and on to their first duty assignment and ultimately the reenlistment decision point. Attrition from a cohort occurs during each phase of training and each year of service. Individuals assigned to a specific A-school may fail and attrite from the Navy or be reassigned as Gendets. Individuals from the Gendet community may qualify for ratings through on-the-job training or assignment to A-school.

The First LOS Cell

Letting X_{1ij} represent the number of individuals who are assigned to and successfully complete the jth A-school during their first year of service, we can write:

$$X_{1ij} = XR_i \; RTCS_i \; P_{ij} \; ASCHS_{ij} \quad ,$$

where

$RTCS_i$ = probability that a quality type i recruit will successfully complete recruit training.

$ASCHS_{ij}$ = probability of success in the jth A-school for a type i individual

$RTCS_i$ and $ASCHS_{ij}$ are parameters in the model, determined using the historical data described in appendix C; XR_i and P_{ij} are the decision variables defined previously.

Letting $X_{1iGendet}$ represent the number of individuals who are part of the Gendet population in LOS cell 1,

$$X_{1iGendet} = XR_i \; RTCS_i \; P_{iGendet} \; ASCHS_{iGendet} + \sum_j (XR_i \; RTCS_i \; P_{ij} \; (1-ASCHS_{ij}) \; STAYER_j) \quad ,$$

where

$STAYER_j$ = probability that an individual who has failed the jth A-school will remain in the Navy as a Gendet.

The first term on the right hand side of the expression for $X_{1iGendet}$ represents individuals who are initially assigned as Gendets. The second term takes account of the A-school failures who then become Gendets.

<u>The Second, Third, and Fourth LOS Cells</u>

The number of individuals in the jth rating at the start of the second year of service, X_{2ij}, is calculated as:

$$X_{2ij} = X_{1ij}\ TERMS_{1i} + X_{1iGendet}\ GENTOA_{1ij}$$

where

$TERMS_{ki}$ = probability that an individual of quality type i who begins year k will complete year k, and

$GENTOA_{kij}$ = the probability that an individual of quality i who begins year k as a Gendet will qualify for rating j during year k.

The number of Gendets at start of the second year is simply:

$$X_{2iGendet} = X_{1iGendet}\ GENCON_{1i}$$

where $GENCON_{ki}$ is the probability that an individual of the ith quality type who begins year k as a Gendet will complete that year as a Gendet.

The numbers of individuals in the different groups at the beginning of the third and fourth years are defined analogously:

$$X_{3ij} = X_{2ij}\ TERMS_{2i} + X_{2iGendet}\ GENTOA_{2ij}\ ,$$

$$X_{3iGendet} = X_{2iGendet}\ GENCON_{2i}\ ,$$

$$X_{1ij} = X_{3ij}\ TERMS_{3i} + X_{3iGendet}\ GENTOA_{3ij},\ \text{and}$$

$$X_{4iGendet} = X_{3iGendet}\ GENCON_{3i}.$$

LOS 5 Inventories

Finally, the number of individuals in each rating and quality type who appear in LOS 5 can be calculated:

$$X_{5ij} = X_{4ij}\ ELIG_{1i}\ REUP_{ij}(BMULT_j) + X_{4ij}\ EXTE_{ij}(BMULT_j) + X_{4ij}\ ELIG_{1i}\ SEXTE_{ij}\ EXTE_{ij}\ (BMULT_j)\ [REUP_{ij}(BMULT_j) + EXTE_{ij}\ (BMULT_j)]\ .$$

$ELIG_{1i}$ = probability that a rated individual in LOS 4 is eligible to reenlist,

$REUP_{ij}(BMULT_j)$ = probability that an eligible individual of quality type i in rating j chooses to reenlist; this probability is a function of the bonus multiple in the jth rating,

$EXTE_{ij}(BMULT_j)$ = probability that an eligible individual of quality type i in rating j chooses to extend his enlistment from 1 to 3 years; this probability is a function of the bonus multiple in the jth rating, and

$SEXTE_{ij}$ = the ratio of the number of extensions of less than 1 year to the number of extensions of 1 to 3 years by individuals of quality type i in rating j.

The first additive term on the right hand side of the equation for X_{5ij} represents those eligible individuals who reenlist at LOS-4. The second term represents individuals at LOS-4 who choose to extend their enlistment for at least 1 year. The final term represents individuals who initially execute a short-term extension (an extension of less than one year) but who subsequently reenlist or extend their term further. We assumed that the probability of extension or reenlistment is the same for individuals with short-term extensions as it is for all eligibles. The derivation of the reenlistment and extension functions used $[REUP_{ij}(BMULT_j)$ and $EXTE_{ij}(BMULT_j)]$ is discussed in appendix E.

Since we do not have estimates of bonus responsiveness for the Gendet community we assumed that the proportion of Gendets eligible to reenlist who reached LOS-5 was constant.

$$X_{5iGendet} = X_{4iGendet}\ ELIG_{2i}\ CONSTANT_i \quad ,$$

where $CONSTANT_i = GENUP_i + GEXTE_i + GSEXT_i\ GEXTE_i\ (GENUP_i + GEXTE_i)$

and

$ELIG_{2i}$ = probability that a Gendet of type i in LOS 4 is eligible to reenlist

$GENUP_i$ = probability that a reenlistment eligible Gendet of quality type i will reenlist,

$GEXTE_i$ = probability that a reenlistment eligible Gendet of quality type i will extend from 1 to 3 years,

$GSEXT_i$ = the ratio of the number of extensions of less than 1 year to the number of extensions of 1 to 3 years by Gendets of quality type i.

CALCULATING THE ACCESSIONS AND TRAINING FLOWS NEEDED TO MEET LOS-5 REQUIREMENTS UNDER ALTERNATIVE BONUS POLICIES

Using simple matrix algebra, we can work backwards through these manpower flows to calculate the accession levels and training flows necessary to meet fixed LOS-5 requirements under alternative sets of bonus multiples.

Let $PROB_{ikj}$ be the probability that an individual of type i initially assigned to the jth A-school will at LOS-4 be eligible to reenlist in the kth rating. This probability is a constant and can be expressed in terms of the parameters in our model. For $k \neq j$,

$$\begin{aligned} PROB_{ikj} = {} & [(1-ASCHS_{1j})STAYER_j][GENTOA_{1ik}\ TERMS_{2i}\ TERMS_{3i} \\ & + GENCON_{1i}\ GENTOA_{2ik}\ TERMS_{3i} + GENCON_{1i}\ GENCON_{2i} \\ & GENTOA_{3ik}]ELIG_{1i} \quad . \end{aligned}$$

The first term in square brackets is the probability of initially failing the jth A-school and becoming a Gendet. The three additive

terms in the second set of brackets take account of the probability that the Gendet will subsequently qualify for the kth rating. For $k = j$,

$$\begin{aligned} PROB_{ikj} = {} & ASCHS_{ij}\ TERMS_{1i}\ TERMS_{2i}\ TERMS_{3i}\ ELIG_{1i} \\ & + [(1-ASCHS_{ij})STAYER_{j}][GENTOA_{1ij}\ TERMS_{2i}\ TERMS_{3i} \\ & + GENCON_{1i}\ GENTOA_{2ij}\ TERMS_{3i} + GENCON_{1i}\ GENCON_{2i} \\ & GENTOA_{3ij}]\ ELIG_{1i} \quad . \end{aligned}$$

The first term on the right hand side of this expression represents the probability that an individuals of type i initially assigned to rating j will remain in that rating and be eligible for reenlistment at LOS-4; the remainder of the expression takes account of the probability that the individuals will initially fail the jth A-school, become a Gendet, and then become qualified for the jth rating at some later point.*

Let $ASSIGN_{ij} = XR_i\ RTCS_i\ P_{ij}$, the number of type i individuals initially assigned to the jth A-school.

For each quality type, the number of eligibles in each rating at LOS-4 ($NELIG_{ij} = X_{4ij}ELIG_{1i}$ for quality type i and rating j) is now calculated readily using matrix multiplication. There is one matrix equation for each quality type; the subscript i for quality type is suppressed for notational simplicity.

$$\begin{bmatrix} PROB_{11} & \cdots & PROB_{1N} \\ \vdots & & \vdots \\ \vdots & PROB_{jk} & \vdots \\ \vdots & & \vdots \\ PROB_{N} & \cdots & PROB_{NN} \end{bmatrix}_i \begin{bmatrix} ASSIGN_1 \\ \vdots \\ ASSIGN_j \\ \vdots \\ ASSIGN_N \end{bmatrix}_i = \begin{bmatrix} NELIG_1 \\ \vdots \\ \vdots \\ \vdots \\ NELIG_N \end{bmatrix}_i$$

* To keep the number of parameters manageable, we assumed that the probability of a Gendet of type i qualifying for rating j in LOS cell k was a constant and did not depend on whether or not the Gendet had previously failed the jth A-school.

To work backwards from LOS-5 requirements (X_{5ij}) under a given set of bonus multiples $(BMULT_j)$, we first used the equations on page A-8 and A-9 to determine the number of eligibles required at LOS-4 in each rating and quality type. Inverting the PROB matrix for each quality type, we then solved for initial training assignments:

$$\begin{bmatrix} PROB_{11} & \cdots & PROB_{1N} \\ \vdots & & \vdots \\ & PROB_{jk} & \\ \vdots & & \vdots \\ PROB_{N1} & \cdots & PROB_{NN} \end{bmatrix}_i^{-1} \begin{bmatrix} NELIG_1 \\ \vdots \\ \vdots \\ NELIG_N \end{bmatrix}_i = \begin{bmatrix} ASSIGN_1 \\ \vdots \\ \vdots \\ ASSIGN_N \end{bmatrix}_i$$

Since $\sum_j ASSIGN_{ij} / RTCS_i = XR_i$ and $ASSIGN_{ij} / (RTCS_i\ XR_i) = P_{ij}$,

this identifies both the accessions (XR_i) and training assignments (P_{ij}) required to meet LOS-5 inventories under the specified bonus policies.

COSTS ASSOCIATED WITH RECRUIT FLOWS

Associated with each set of accession, training assignment and reenlistment bonus policies is a set of costs. These include recruiting, AFEES processing, recruit training, A-school training, and reenlistment bonus costs. The aggregate costs for a recruit cohort is the sum of these components:

$$AG\ COST = REC\$ + TAFEE\$ + TRTC\$ + TASCH\$ + TBON\$\ .$$

Recruiting Costs (REC$) and AFEES Processing Costs (AFEE$)

Recruiting costs are a function of the number of high school diploma graduates recruited; $REC\$ = REC\$\ (XR_1 + XR_2)$. The derivation of the recruiting cost function is discussed in appendix D. An important feature of the cost function used is that increases in $XR_1 + XR_2$ are associated with exponential increases in the costs of Navy recruiters and advertising.

The costs of the Armed Forces Entrance Exams, also discussed in appendix D, are a simple linear function of the number of recruits:

$$TAFEE\$ = \sum_i PROC\$_i XR_i \quad ,$$

where $PROC\$_i$ is the processing cost for each type i recruit.

Recruit Training Costs (TRTC$)

Total recruit training costs depend on the number of recruits of each quality type:

$$TRTC\$ = \sum_i RTC\$ \; XR_i \; RTCS_i \quad ,$$

where $RTC\$$ is the cost per recruit training graduate of quality type i.

Total A-School Training Costs (TASCH$)

Estimates of $ASCH\$_{ij}$, the cost per graduate of quality type i for the jth A-school were developed for this study [6] using data provided by CNET. As we do not have estimates of on-the-job training costs for the different ratings, we also used $ASCH\$_{ij}$ for the cost of preparing a Gendet of type i for rating j through on-the-job training.

Total A-school training costs in the model are:

$$TASCH\$ = \sum_i \sum_j XR_i \; RTCS_i \; P_{ij} \; ASCH_{ij} \; ASCH\$_{ij} + {}_{1iGendet} \; GENTOA_{1ij}$$

$$ASCH\$_{ij} \frac{1}{1+r} + X_{2iGendet} \; GENTOA_{2ij} \; ASCH\$_{ij} \frac{1}{(1+R)^2} \quad ,$$

$$+ X_{3iGendet} \; GENTOA_{3ij} \frac{1}{(1+r)^3} \; ASCH\$_{ij}$$

where r is a 10-percent discount rate and the remaining variables are as defined previously.

Total Reenlistment Bonus Costs

Given estimates of base pay at LOS-4 for individuals of different quality types and an average reenlistment contract length of approximately 4 years, we estimated $BONUS_{ij}\ (BMULT_j)$. This is the cost of the reenlistment bonus for an individual of quality type i in the jth rating. Bonus costs are attributed to those who reenlist immediately at LOS-4 and to those short-term extenders who subsequently reenlist.

$$TBON\$ = \sum_i \sum_j X_{4ij}\ ELIG_{1i} REUP_{ij}\ (BMULT_j)\ [1 + EXTE_{ij}\ (BMULT_j)\ SEXTE_{ij}]\ BONUS_{ij}(BMULT_j)\ \frac{1}{(1+r)^4}$$

APPENDIX B

GROUPING RATINGS

APPENDIX B

GROUPING RATINGS

Ideally, the balance between accession and retention should be determined simultaneously for each of the Navy's ratings. In practice, however, it is not possible to consider every rating separately due to the number of trade-offs that must be examined. In addition, the parameters that relate reenlistment behavior to military pay have themselves only been estimated for groups of ratings. This grouping was necessary for estimation purposes because in some ratings there has been very little historical variation in pay.

Estimates of the responsiveness of reenlistments to pay are available from previous CNA work for 16 groups of ratings [4]. These groups were determined on the basis of subjective judgments about similarities in occupations and work environments. For the purposes of the current study in which training costs play an important role, some of these rating groups were subdivided to take into account differences in training costs.* This resulted in the 28 groups shown in table B-1. In each case where rating groups were subdivided the new groups were assumed to have the same responsiveness to pay as the group from which they derived.

In addition, two ratings for which we did not have any responsiveness estimates, GS and TD, were assigned to groups with similar types of duties and A-school training costs.

Twelve rating groups are not considered in our analysis. RP is a new rating so that no one has, as yet, completed the first 5 years of service. Eight ratings, AF, AV, CU, EQ, PI, NC, LN, and MA, contain no first-termers. The other three ratings, MT, EW, and DS, were excluded because they are composed almost entirely of 6-year obligors.

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* Other changes from the groups used in reference [4] resulted from our initial use of an earlier set of responsiveness coefficients.

TABLE B-1

RATING GROUP AND RECRUIT QUALITY TYPES

Recruit Quality Types

1. High school diploma graduates in the upper mental groups (I-IIIU)
2. High school diploma graduates in the lower groups (IIIL-V)
3. Non-graduates in the upper mental groups (I-IIIU)
4. Non-graduates in the lower mental groups (IIIL-V)

Rating Groups

Technical

1. ET (Electronics Technician)
2. FT (Fire Control Technician)
3. AE (Aviation Electricians Mate), AQ (Aviation Fire Control Technician), AT (Aviation Electronics Mate), AX (Antisubmarine Technician), TD (Training Device Technician)
4. ST (Sonar Technician)

Semi-Technical

5. EM (Electricians Mate), IC (Interior Communications Electrician)
6. IM (Instrumentman), ML (Molder), OM (Opticalman), PM (Pattermaker)
7. DT (Dental Technican), HM (Hospital Corpsman)
8. MR (Machiner Repairman)
9. MM (Machinists Mate)
10. AD (Aviation Machinists Mate), AM (Aviation Structural Mechanic), AS (Aviation Support Equipment Technician)
11. AC (Air Controlman), AW (Aviation ASW Operator)
12. AO (Aviation Ordnancemen)
13. BU (Builder), CE (Construction Electrician), CM (Construction Mechanic), EA (Engineering Aid), EO (Equipment Operator), SW (Steelworker), UT (Utilitiesman)
14. OS (Operations Specialist), QM (Quartermaster)
15. DP (Data Processing Technician)
16. RM (Radioman)
17. OR (Ocean Systems Technician)
18. GM (Gunners Mate), TM (Torpedoman)
19. MN (Mineman)
20. CT (Crypologic Technician), IS (Intelligence Specialist)
21. DM (Illustrator Draftsman), JO (Journalist), LI (Lithographer), MU (Musician), PH (Photographers Mate)

TABLE B-1 (Cont'd)

Non-Technicial

22. HT (Hull Maintenance Technician)
23. AK (Aviation Storekeeper), DK (Disbursing clerk), SH (Ships Serviceman), SK (Storekeeper), MS (Mess Management Specialist)
24. BT (Boiler Technician)
25. AB (Aviation Boatswains Mate), PR (Aircrew Survival Equipmentman)
26. AG (Aerographers Mate), AZ (Aviation Maintenance Administration Man), PC (Postal Clerk), PN (Personnelman), YN (Yeoman)
27. BM (Boatswains Mate), SM (Signalman)
28. Gendet; General Detail Personnel

APPENDIX C

DESCRIPTION OF DATA

APPENDIX C

DESCRIPTION OF DATA

DEVELOPMENT OF TRANSITION AND COST PARAMETERS

The NACCS simulation model requires the input of cost and attrition parameters. The data elements needed to determine these parameters were obtained from several sources. Here we identify the sources and describe the required data elements. All cost figures are presented in 1982 dollars. The recruit quality types for which parameters were calculated are:

1 = HSDG 1-3U
2 = HSDG 3L-4
3 = NHSDG 1-3U
4 = NHSDG 3L-4

SURVIVAL PARAMETERS

Recruit Training Survival ($RTCS_i$)

The probability that an individual survives recruit training was calculated from data supplied by the Navy Recruiting Command. This data set lists each person who joined the Navy and indicates recruit training completion or attrition. Overall, 88.3 percent of recruits completed recruit training, but there were significant differences across quality types. Completion rates ranged from 92.7 percent for Quality 1 recruits to 82.5 percent for Quality 4 recruits.

A School Survival ($ASCHS_{ij}$)

The probability that an individual will survive through specialized training was calculated using data from the Chief of Naval Education and Training (CNET). CNET's Student Master File (SMF) is a transaction file kept by the Navy Integrated Training and Resources Administration System (NITRAS). This file shows each course taken by each student and the date of completion or attrition. The SMF for FY 1979 was merged with the Enlisted Master Record (EMR) for December 1980 so that the quality type of each individual could be ascertained.

CNET supplied a listing of the courses necessary for qualification in each rating. The probability of completing a rating pipeline was determined by multiplying the conditional probabilities of completing each course within that pipeline, given that all previous courses in the pipeline had been completed. In rating groups where more than one pipeline led to qualification, the probability of completing each was weighted by the number of graduates to obtain the probabilities of

completing training for each quality type for the rating group as a whole.

Class A school survival rates vary significantly across both rating groups and quality types. Table C-1 shows the mean, standard deviation, and high and low values by quality type for this parameter.

TABLE C-1

A-SCHOOL SURVIVAL

	Quality type 1	Quality type 2	Quality type 3	Quality type 4
Mean	.87	.81	.73	.69
Standard deviation	.14	.15	.17	.23
High value	1.00	1.00	1.00	1.00
Low value	.43	.35	.21	0

Although ideally this parameter should be calculated using data for 4YOs only, the NITRAS data base does not differentiate by length of service obligation. Since quality type is controlled for, bias in these numbers as a result of the inclusion of non-4YOs is expected to be minimal.

Assignment of A School Failures ($STAYER_j$)

The probability that a person who fails A-school will complete apprenticeship training and become a Gendet was found from the SMF type for 1979. In the model, A-school failures either separate from the Navy or are reassigned to the Gendet population. In reality, some school failures are reclassified and enroll in a different A-school. The model was simplified to exclude this flow, because available data did not allow us to determine the subsequent A-school success or failure of this group.

The percentages of failures who, in reality, become Gendets or leave the Navy were found directly from the SMF tape. However, it was necessary to assign those failures who actually changed ratings to one of the options available in the model. Thus, the percentage of failures who became Gendets was augmented to include a proportion of those who reclassified. The reclassified failures were assigned to leave or become Gendets in the same proportion as those categories appear in the unaugmented data.

The percentage of failures who become Gendets varies significantly across rating groups, but not across quality types. On average,

91 percent of failures become Gendets. Across ratings, the proportion of failures who become Gendets varies from 1 to .7.

First, Second, and Third Year Survival ($TERMS_{1i}$, $TERMS_{2i}$, $TERMS_{3i}$)

The probability that an individual survives from the end of A-school to year 2 was found by comparing EMRs for September 1979 and September 1980. Individuals in a rating with more than 5 months but less than 13 months of service in the 1979 tape were traced on the 1980 tape.

The probabilities of survival from year 2 to year 3 and from year 3 to year 4 were also determined by comparing the two EMRs.

Significant differences in term survival rates were found across quality type and length of service cells but not across rating. Table C-2 shows the yearly survival rates for each quality type.

TABLE C-2

TERM SURVIVAL

	Quality type 1	Quality type 2	Quality type 3	Quality type 4
End of A-school to year 2	.96	.97	.92	.92
Year 2 to year 3	.96	.97	.92	.92
Year 3 to year 4	.96	.96	.93	.93

Gendet First, Second, and Third Year Survival ($GENCON_{1i}$, $GENCON_{2i}$, $GENCON_{3i}$)

The probability that an individual who successfully completes apprenticeship training will stay in the Navy and remain a Gendet to year 2 was also found by comparing the September 1979 with the September 1980 EMR.

The probabilities that a Gendet of a given quality type who remains a Gendet to year 2 will stay in the Navy and remain a Gendet to year 3 and 4 were also determined in the same manner.

As with term survival in the ratings, significant differences in Gendet survival were found across quality types and length of service. Table C-3 presents the yearly survival rates for each quality type.

TABLE C-3

GENDET TERM SURVIVAL

	Quality type 1	Quality type 2	Quality type 3	Quality type 4
End of apprenticeship to year 2	.63	.75	.70	.72
Year 2 to year 3	.54	.62	.64	.68
Year 3 to year 4	.45	.45	.53	.56

Gendet Qualification for Rating at the End of the First, Second and Third Year of Service ($GENTOA_{1ij}$, $GENTOA_{2ij}$, $GENTOA_{3ij}$)

The probability that a Gendet will qualify for a rating either through A-school attendance or on-the-job training was calculated with coefficients from the logit regression equation. This equation relates the probability of a Gendet's becoming rated to length of service, quality type, rating, and the interaction of quality type and the technical difficulty of the rating. A detailed explanation of this equation can be found in appendix E.

Table C-4 shows the probability that a Gendet of a given quality type will qualify for any rating during each of the first 3 years. It also shows the high value of the probability of qualification for a particular rating for each year and quality type. (The low value is approximately zero.)

TABLE C-4

GENDET QUALIFICATION FOR RATINGS

Year	Quality type	All ratings	High value for a single rating
1	1	.20	.02
1	2	.14	.01
1	3	.08	.01
1	4	.06	.01
2	1	.34	.06
2	2	.31	.04
2	3	.18	.03
2	4	.15	.03
3	1	.44	.07
3	2	.47	.06
3	3	.19	.06
3	4	.31	.06

Eligibility for Reenlistment ($ELIG_{li}$)

The probability that an individual is eligible to reenlist at the end of the first term was found using EMRs from June 1978, December 1979, September 1979, and December 1980. The percentage of individuals eligible to reenlist was calculated by examining the eligibility codes for those with a reenlstment decision in FY 1979 or FY 1980. Individuals were assumed to be at a reenlistment point if they had a change in EAOS during the relevant period.

Significant differences were found in the probability of being eligible to reenlist between Gendets and all rated personnel, although not across individual rating groups. In addition, in both the Gendet and rated groups, high school diploma graduates were more likely to be eligible to reenlist than non-high school graduates. Table C-5 shows the eligibility rates used in the model.

TABLE C-5

ELIGIBILITY RATES

	HSDG	NHSDG
Gendets	.67	.55
Rated groups	.93	.87

Short-Term Extensions ($SEXTE_{ij}$)

The ratio of extensions of less than 12 months to extensions of 12 to 35 months for each rating group was calculated by comparing the June 1980 and September 1981 EMRs. Averaging across ratings, the ratio varies from 1.2 to .8 depending on quality type. (Because of sample size problems, quality specific ratios were calculated for each rating using the average within-rating quality differential.)

Gendet Reenlistment Rate ($GENUP_i$)

The probability that a Gendet of a given quality type who is eligible to reenlist in fact reenlists was determined by comparing the June 1980 and September 1981 EMRs. Any Gendet with an EAOS change of 36 months or more is considered a reenlistee. The Gendet reenlistment rate varies across quality type from .04 to .08.

Gendet Extension Rate ($GEXTE_i$)

The probability that a reenlistment eligible Gendet of a given quality type extends for a period of from 12 to 35 months was found by comparing the June 1980 and September 1981 EMRs. This rate varies from .06 to .11 depending on quality type.

Gendet Short Term Exensions ($GSEXT_i$)

The ratio for Gendets of extensions of less than 12 months to extensions of 12 to 35 months was calculated by comparing the June 1980 and September 1981 EMRs. This ratio varies across quality types from 1.3 to 2.4.

COST PARAMETERS

Recruiting and AFEES Processing Costs (REC$)

A recruiting cost function for high school diploma graduates was developed from a CNA recruit supply function [1]. It is characterized by increasing marginal costs. Derivation of the cost function is discussed in appendix D. At current HSDG recruit levels, the marginal cost of a recruit is $4300.

AFEES processing costs for both high school and non-high school graduates were calculating using data from the Navy Recruiting Command, the Defense Manpower Data Center, and the Military Enlisted Personnel Processing Command. In 1982 dollars, AFEES processing costs are $117 for each HSDG and $325 for each NHSDG recruit.

Recruit Training Costs ($RTC\$_i$)

An estimate of the average cost per graduate of recruit training was obtained from CNET. This average was adjusted to account for variations in attrition across quality types to obtain quality-dependent cost figures. The adjusted costs vary from $2756 for Quality 1 recruits to $2930 for Quality 4 recruits.

A-School Training Costs ($ASCH\$_{ij}$)

The cost of a particular training program per graduate was determined using information supplied by NITRAS and the Training Analysis and Evaluation Group (TAEG). NITRAS data includes a listing of required courses for qualification in each rating. TAEG has a model which gives the average cost per graduate from each course. Our use of this model is discussed in [6].

Adjustments were made to account for differential attrition by quality type. Table C-6 shows the mean A-school costs for each quality type. The average cost of A-school is lowest for upper mental group high school graduates and highest for lower mental group non-high school graduates.

TABLE C-6

A-SCHOOL COSTS

	Quality type 1	Quality type 2	Quality type 3	Quality type 4
Mean	$ 7,843	$ 8,226	$ 8,640	$ 9,498
Standard deviation	4,272	4,583	4,623	5,940
High value	19,009	20,300	18,905	27,022
Low value	1,355	1,355	1,355	1,355

Bonus Payments ($BONUS_i$)

Bonus payments are calculated under the assumption that all reenlistments are for 4 years. The bonus payment is then 4 times the product of monthly base pay and the bonus multiple.

Discounting Future Cash Flows

Future cash flows are discounted at an annual rate of 10 percent.

APPENDIX D

DOCUMENTATION OF RECRUITING COST ESTIMATES

APPENDIX D

DOCUMENTATION OF RECRUITING COST ESTIMATES

THE UNDERLYING SUPPLY FUNCTION

Our estimate of the cost of recruiting NPS male HSDGs is derived from a preliminary model of Navy recruit supply which was developed by Larry Goldberg of CNA for the Navy Enlisted Supply study. This model predicts the number of HSG contracts relative to the male population aged 17-21 in each Navy Recruiting District (HSG/POP). The equations were estimated using OLS and pooled cross section, time series data which cover each of the 43 districts in 1977, 1978, 1979.

$$1) \quad \frac{HSG}{POP} = 4.39 + 2.96\ \ell n(\frac{R}{POP}) - 4.87\ \ell n\ \text{PAY RATIO} + 1.82\ \ell n(\frac{AIRFR}{POP}) - .72\ \ell n(\frac{CC}{POP}) - .37\ \ell n(\frac{CY}{POP}) + .97\ \ell n(\frac{L}{POP}) + 2.36\ \ell n\ \text{UNEMP} + \mu$$

$$2) \quad \ell n(\frac{L}{POP}) = -1.97 - 1.31\ \ell n\ \text{PAY RATIO} + .28\ \ell n\ \text{UNEMP} + .27\ \ell n(\frac{CY}{POP}) + .094\ \ell n(\frac{CC}{POP}) + .25\ \ell n(\frac{TVR}{POP}) + .10\ \ell n(\frac{AD}{POP}) + \ell \quad .$$

Definitions of the variables and the values of the t statistics are provided in tables D-1 and D-2. A reduced form equation for HSG/POP is obtained by substituting the second equation into the first. This two-equation structural model incorporates the view that advertising affects the number of contracts only through its impact on leads and that all leads--regardless of source--are equally effective in generating contracts.*

Holding constant the economic and demographic variables not controlled by the Navy, the total number of HSG contracts obtained in any year is thus a function of 88 variables: the level of recruiters in each of the 43 districts, the level of printed media advertising in each

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* In later work, we modified this model, estimating the number of contracts directly as a function of the Navy advertising variables. While the coefficients of the advertising variables are sensitive to this alternative treatment, the basic form of the recruiting cost function and the major conclusions cited below are not affected.

TABLE D-1

DEFINITION OF VARIABLES[a]

Variable	Definition
(by Navy Recruiting Districts and Year) HSG	The number of NPS male HSG Navy contracts
POP	Male population aged 17-21, in thousands
R	Navy recruiters, in man-months
PAYRATIO	Average full-time earnings of 18 year old civilian males divided by first year's regular military compensation
AIRFR	The number of Air Force recruiters (in man years)
CC	Expenditures on CETA countercyclical programs
CY	Expenditures on CETA youth programs
UNEMP	Civilian unemployment rate
L	Contacts with potential recruits obtained through advertising
TVR	Expenditures on television and radio advertising
AD	Expenditures on magazine, billboard, and direct mail advertising

[a]These data are from the data base developed by CNA for the Navy Enlisted Supply Study, CNS 1168.

TABLE D-2

PRELIMINARY SUPPLY MODEL FOR NPS MALE HSG CONTRACTS[a]

	Equation 1 dependent variable: HSG/POP		Equation 2 dependent variable: ℓn(L/POP)		Equation 3 HSG/POP (reduced form obtained by substitution of equation 2 into equation 1)
Explanatory variables[b]	Coefficient	(t(121))	Coefficient	(t(122))	
ℓn(R/POP)	2.96	5.51			2.96
ℓn(PAYRATIO)	-4.87	-5.55	-1.31	-5.02	-6.14
ℓn(AIRFR/POP)	1.82	3.21			1.82
ℓn(CC/POP)	-.72	-2.93	.09	1.15	-.63
ℓn(CY/POP)	-.37	-.83	.27	1.91	-.11
ℓn UNEMP	2.36	6.89	.28	2.43	2.63
ℓn(L/POP)	.97	3.45			
ℓn(TVR/POP)			.25	2.16	.24
ℓn(AD/POP)			.10	2.65	.10
CONSTANT	4.39	1.68	-1.97	-2.82	2.48
R^2	.71		.43		
SEE	.91		.28		
Mean of dependent variable	6.04		2.51		

[a]These are estimates of a preliminary supply model developed by CNA for the Navy Enlisted Supply Study, CNS 1168.
[b]ℓn refers to the natural logarithm.

district, and the level of military pay and of national advertising. As most of the national television and radio advertising is purchased through national networks--rather than being obtained via more expensive spot purchases from local stations--we assume that the Navy controls only the aggregate level of this advertising, with the distribution across districts determined by historical viewing and listening patterns.

DERIVATION OF THE COST FUNCTION

Fortunately, a minimum recruiting cost function for 1979 can be derived from an aggregate supply function which is based on only three variables: the aggregate number of recruiter man-months (R_T); aggregate expenditures on printed media advertising (AD_T); and the level of national advertising (TVR_T). This is because--given the functional form of the supply equation and given price estimates for recruiters and advertising which do not vary across districts*--equality in the ratio of prices to marginal products (a condition which holds when costs are minimized) implies that the ratio of recruiters to population and the ratio of advertising to population do not vary across districts. Multiplying each side of equation 3 on table D-2 by population and aggregating across districts, we obtain the following equation:

$$HSG_T = -326719.2 + 31299.0\ln R_T + 1057.4\ln AD_T + 2537.8\ln TVR_T \quad . \qquad (1)$$

This is a relationship that holds when costs are minimized. The constant term incorporates the effects of the economic and demographic variables which enter into equation 3 in table D-2 but which are not directly controlled by the Navy.** This constant is calculated using the 1979 value for these variables.

* The estimated annual marginal cost of a Navy recruiter in 1979 is $26,000 (see [11] for the calculation of this marginal cost figure). The cost per recruiter man-month is thus $2,170. Each unit of advertising--printed or national--costs 1.2 1979 dollars. The figure 1.2 represents an inflation adjustment; this is necessary since the supply equations are estimated using expenditures on advertising in 1977 dollars. All costs in this appendix are expressed in 1979 dollars.
** This includes military pay. Allowing the Navy to raise compensation by giving enlistment bonuses does not change the cost function (see p. D-10, below).

We now equate the ratios of prices to marginal products for the aggregate recruiting variables to obtain the following relations:*

$$AD_T = 61.1 \times R_T \quad . \tag{2}$$

$$TVR_T = 152.7 \times R_T \quad . \tag{3}$$

Substituting (2) and (3) for AD_T and TVR_T in equation (1) and then solving for R_T yields:

$$R_T = e^{\frac{HSG_T + 309599.7}{34894.2}} \quad . \tag{4}$$

The cost of recruiting and advertising resources is:

$$TC = 2170 \times R_T + 1.2\, AD_T + 1.2\, TVR_T \quad . \tag{5}$$

Using (2) and (3) to substitute for AD_T and TVR_T in equation (5) and then substituting (4) for R_T, the final form of the minimum recruiting cost function emerges:

$$\text{Minimum Cost} = 2426.5 \times e^{\frac{HSG_T + 309599.7}{34894.2}} \quad .$$

THE ACTUAL VS. THE OPTIMAL ALLOCATION OF RECRUITERS AND ADVERTISING

Table D-3, which is based on this cost function, shows the minimum recruiting costs associated with different numbers of HSG contracts, together with the optimal number of recruiters and the optimal levels of advertising expenditures. The minimum expenditure necessary to obtain 58,000 recruits in 1979 was 91.2 million dollars. This includes expenditures on printed advertising of 2.8 million dollars and on national advertising of 6.8 million. 3,133 recruiters account for 90 percent of the total minimum cost. The resources actually utilized to obtain

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* $$\frac{31299.0}{R_T x 2170} = \frac{1057.4}{AD_T X1.2} = \frac{2537.8}{TVR_T X1.2} \quad .$$

58,000 HSG recruits in 1979 include 3,454 recruiters, 6.1 million dollars of national advertising and .9 million of printed media advertising. The estimated cost of these resources is 96.9 million. From this cost function, we conclude that recruiting resources were reasonably well allocated, although a shift away from recruiters and toward printed advertising would have saved approximately 5 million dollars.

TABLE D-3

RECRUITING COST SCHEDULE BASED ON
1979 ECONOMIC AND DEMOGRAPHIC CONDITIONS
(All values in 1979 dollars)

NPS	Recruiters (in man-years)	Expenditures on printed advertising	Expenditures on national TV and radio	Total cost	Marginal cost
50,000	2,491	$2.1M	$ 5.5M	$ 72.5M	$2,049K
55,000	2,875	2.5	6.4	83.7	2,365
58,000	3,133	2.8	6.8	91.2	2,729
60,000	3,317	2.9	7.3	96.6	2,808
65,000	3,829	3.4	8.4	111.5	3,150
70,000	4,419	3.8	9.7	128.7	3,635
75,000	5,099	4.4	11.2	148.5	4,195
80,000	5,885	5.2	12.9	171.4	4,842
85,000	6,792	6.0	14.9	197.8	5,587

RECRUITING COSTS WITH VARIABLE COMPENSATION

If adjustments in compensation as well as in the level of recruiters and advertising are viewed as a recruiting tool the derivation of a recruiting cost function becomes more complex. One issue that arises is the impact of a pay increase on enlistments relative to the impact of a bonus.

Although this is an empirical question, there is little direct evidence on which to base a judgement. One frequently used indirect approach is to assume that the ratio of annual civilian to military pay in the recruit supply equation (PAYRATIO) represents the ratio of the PDV of civilian earnings relative to the PDV of military compensation over the recruits' first four-year term:

$$\text{PAYRATIO} = \text{CIVPAY} \sum_{t=0}^{3} (1+r_t)^{-t} \;/\; \text{MILPAY} \sum_{t=0}^{3} (1+r_t)^{-t} \quad ,$$

where r_t is the discount rate less the rate of real wage growth. (This equality assumes that r_t for $t=0,3$ is the same in the military as in the civilian sector.) Under this approach, a military pay raise of $100 will have the same impact as a bonus with the same

$$PDV(100 \sum_{t=0}^{3} (1+r)^{-t}) .$$

The problem of selecting an appropriate discount rate remains. Surveys of military personnel in which individuals are asked to choose between bonuses and pay increases indicate that first term personnel have high discount rates, with estimates ranging from 20 to 28 percent. At the same time, it is conventional to assume a 10 percent discount rate for the Navy. The discrepancy between these discount rates leads to the anomalous conclusion that the Navy will meet its recruiting goals while minimizing the PDV of compensation (using the 10 percent rate) if all compensation is given in the form of enlistment bonuses. In order to provide a more realistic problem, we will simply assume that a minimum level of pay (the actual level for 1979) is to be given and then consider the optimal enlistment bonus, if any.

Taking this approach, we find that even if recruits are assumed to have a one-year time horizon--so that a $100 bonus has the same impact as a $100 per year pay increase--the use of a general enlistment bonus for HSGs is not cost-effective from the Navy's perspective. With a recruit cohort of 60,000 and a 1979 pay level of $7,617, the cost to the Navy of attracting an additional HSG using an enlistment bonus is approximately $7,000,* this is $4,300 above the marginal cost shown in table D-3, where the recruits are attracted using advertising and recruiters. As the cohort size increases, so does the marginal cost of a recruit obtained by means of a bonus. With a cohort of 80,000 and an initial military pay level of $7,617, this cost rises to $9,400. This is approximately $4,600 above the corresponding marginal cost shown in table D-3. If we assume that the recruits have a 20 percent discount rate, the cost of obtaining an additional NPS male HSG recruit by the

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* When military compensation is allowed to vary and removed from the constant term, the aggregate equation for HSG's can be written:

$$HSG_T = -907021.1 + 31299.0\ \ell nR + 1057.4\ \ell nAD + 2537.8\ \ell nTVR + 64924.4\ \ell n(MILPAY).$$

Given our assumption with respect to the time horizon, the recruit is indifferent between a pay raise of $100 and a bonus of $100. MILPAY is thus equal to military pay plus the enlistment bonus. The marginal cost of a recruit attracted through an increase in MILPAY is: $\partial MILPAY/\partial HSG_T \times HSG_T = 7617/64924.4 \times HSG_T = \$7,000$ for MILPAY = $7,617 and $HSG_T = 60,000$. In order to make this marginal cost comparable to the costs shown in table D-2, we do not include the cost of compensation ($7,617) paid to the additional recruit.

of these situations, although the cost of obtaining a recruit through the use of recruiters and advertising would be unchanged. We conclude that allowing the Navy to give enlistment bonuses which are greater than or equal to zero does not change our minimum cost function, as the optimal level for such a bonus is zero.

MODIFICATIONS OF THE RECRUITING COST FUNCTION NECESSARY FOR THE NACCS MODEL

The Exclusion of Non-Diploma Graduates

The Navy recruiting supply and recruiting cost functions derived above apply to all non-prior service male recruits who are high school graduates (HSGs). These include both high school diploma graduates (HSDGs) and non-diploma graduates (GEDs). Because the NACCS model distinguishes between diploma and non-diploma graduates, we had to modify the recruiting cost function to exclude the non-diploma graduates. We did this by assuming that the resources necessary to recruit 107 high school graduates (HSDGs and GEDs) would attract 100 HSDGs. As shown in table D-4, DMDC data on Navy recruit contracts indicate that over fiscal years 1977, 1978 and 1979 approximately seven percent of the HSG recruits were non-diploma graduates.

TABLE D-4

NAVY NON-PRIOR SERVICE MALE CONTRACTS:
NON-DIPLOMA GRADUATES AS PERCENT OF TOTAL GRADUATES[a]

	FY 1977	FY 1978	FY 1979	FY 1980
All Mental Categories	.06	.08	.08	.10
Mental Categories 1-3 Upper:	.06	.09	.10	.12
Mental Categories 3 Lower-4	.06	.05	.05	.06

[a]Data supplied by DMDC.

Incorporating this into the cost function reported on p. D-6 above, we obtain the following:

$$\text{Minimum Recruiting Cost} = 2426.5 \times e^{\left(\frac{\text{HSDG} \times 1.07 + 309599.7}{34894.2}\right)} .$$

While a more exact estimate of recruiting costs for diploma graduates might obtained by direct derivation from a recruit supply equation for HSDGs, a comparison reveals little difference between the HSG recruit supply equation from which our original cost function is derived and a recruit supply function estimated solely for HSDGs.*

The Exclusion of Recruits with Other Than a 4-Year Service Obligation

The NACCS model is designed to simulate the costs associated with varying the flows of non-prior service males with 4-year service obligations. The flows of recruits with 3, 5, or 6-year obligations are not dealt with directly. Yet as the costs of recruiting an additional HSDG for a 4-year service obligation depends on the total number of HSDGs recruited, the NACCS cost function must take into account the recruiting requirements for HSDGs with these other service obligations. In calculating recruiting costs for HSDGs with 4-year obligations, we assumed that an additional 24,100 HSDGs were needed to fill these requirements. (In FY 1979, this was the actual number of non-prior service male recruits with high school diplomas and service obligations of 3, 5, or 6 years.) Given these requirements, the minimum cost of recruiting X number of HSDGs for 4-year obligations is the cost of recruiting X + 24,100 HSDGs less the cost of recruiting 24,100 HSDGs.**

The recruiting cost function for HSDGs with 4-year obligations which results is:

$$\begin{aligned}\text{Minimum Recruiting Cost} &= 2426.5xe^{\frac{(X+24100)x1.07+309599.7}{34894.2}} \\ &\quad - 2426.5 \times e^{\frac{24100x1.07+309599.7}{34894.2}} \\ &= 2426.5xe^{\left[\frac{X}{32611.4} + 9.611\right]} - 36.24x10^{6}\end{aligned}$$

With the addition of AFEES testing costs, this is the recruiting cost function utilized in the NACCS study for HSDGs.***

* This comparison is presented in [5].
** This involves the implicit assumption that the cost of recruiting a given total number of HSDG recruits with the prevailing mental group distribution will not be affected by the level of requirements for HSDG recruits with service obligations of other than four years.
*** When used in the NACCS model, costs are expressed in 1982 dollars rather than the 1979 dollars.

The Inclusion of AFEES Processing Costs for HSDG and Non-HSDG Recruits

The number of non-HSDG recruits is believed to be limited by Navy policy rather than by the available supply. In this sense, the marginal cost to the Navy of attracting a non-HSDG recruit is zero. There are, however, processing costs the Navy incurs as the non-HSDG applicants are interviewed, screened, and tested. These costs may actually be greater for the non-HSDG recruits than they are for the HSDG recruits. One processing cost we were able to identify is the cost of AFEES processing. In 1982 dollars, it averaged \$330 for non-HSDG recruits and \$120 for HSDG recruits.

The term \$120 x HSDG is added to the cost function developed previously to give the recruiting cost function for non-prior service males with high school diplomas and 4-year obligations. For the non-prior service males with 4-year obligations who do not have high school diplomas, we assume that \$330 x NHSDG yields a lower bound for recruiting costs.

APPENDIX E

REENLISTMENT PROBABILITIES AND EXTENSION PROBABILITIES AS FUNCTIONS OF BONUS MULTIPLES

APPENDIX E

REENLISTMENT PROBABILITIES AND EXTENSION PROBABILITIES AS FUNCTIONS OF BONUS MULTIPLES

FUNCTIONAL FORM USED

In the NACCS model, the probability of reenlistment for a quality type i individual in the jth rating ($REUP_{ij}$ $(BMULT_j)$) and the probability of extending ($EXTE_{ij}$ $(BMULT_j)$) can be expressed:

$$REUP_{ij}\ (BMULT_j) = \frac{e^{\beta_j}\ (\overline{RMC}_{ij} + \overline{BONUS}_{ij}\ (BMULT_j)) + ALPHAR_{ij}}{D_{ij}}$$

and

$$EXTE_{ij}\ (BMULT_j) = \frac{e^{\beta_{ij}}\ (\overline{RMC}_{ij}) + ALPHAE_{ij}}{D_{ij}} \quad ,$$

where D_{ij} is the sum of the two numerators and where:

$\overline{RMC}_{ij}$ = annualized value of 2nd term RMC for a quality type i individual in rating j

$\overline{BONUS}_{ij}$ = annualized value of the reenlistment bonus for a quality type i individual in the jth rating. This is a function of the bonus multiple: $\overline{BONUS}_{ij}$ = $BONUS_{ij}(BMULT_j)$

$ALPHAR_{ij}$ = a constant that incorporates the effects on reenlistments of civilian pay alternatives and other (nonpecuniary) variables assumed to remain fixed for quality type i individuals eligible to reenlist in the jth rating

$ALPHAE_{ij}$ = a constant that incorporates the effects on extensions of civilian pay alternatives and other (nonpecuniary) variables assumed to remain fixed for quality type i individuals eligible to reenlist in the jth rating

These functional forms correspond to those for a trichotomous logit model under the assumption that the civilian pay alternatives for each rating and quality type remain fixed.*

ESTIMATES OF BONUS RESPONSIVENESS

Estimates of β_j--the responsiveness of reenlistments and extensions in the jth rating to the annualized value of military compensation--were based on the probit coefficients reported in [4]. Each was increased by a factor of 1.6 to adjust for the logistic form of the reenlistment function used in the NACCS model [12,13]. In addition, each coefficient was adjusted for changes in the price level between 1974--the base year for which they were estimated--and 1979, the base year for our model.

We assume that increases in reenlistments in response to pay are proportionately drawn from the extension and leave populations. Given this assumption, βs estimated for the two-choice model are identical to those for the three choice model used in NACCS. The probability of reenlisting in the dichotomous model estimated in reference [4] is really the probability of reenlisting given that the individual either reenlists or leaves. In the trichotomous model, this can be written as:

$$\frac{P_R}{P_R + P_L} = \frac{e^{\beta(RMC + BONUS) + ALPHAR}}{e^{\beta(CIV) + ALPHA_L} + e^{\beta(RMC + BONUS) + ALPHAR}}$$

This result is the probability of reenlistment in the two-choice model. Thus βs estimated using the dichotomous logit model can be inserted into the trichotomous logit model for predictive purposes.

---

* To see this, divide each equation in the trichotomous model below by $e^{\beta(CIV) + ALPHAL}$:

$$\text{Probability of reenlistment} = \frac{e^{\beta(\widetilde{RMC}+\widetilde{BONUS}) + ALPHAR}}{D}$$

$$\text{Probability of extension} = \frac{e^{\beta(\widetilde{RMC}) + ALPHAE}}{D}$$

$$\text{Probability of leaving} = \frac{e^{\beta(\widetilde{CIV}) + ALPHAL}}{D},$$

where $\widetilde{CIV}$ is the annualized value of civilian pay.

CALCULATION OF $ALPHAR_{ij}$ AND $ALPHAR_{ij}$

The simulation model uses $ALPHAR_{ij}$s and $ALPHAE_{ij}$s calculated from 1981 base reenlistment and extension rates. Pay for 1979 was adjusted to account for both military pay increases from 1979 to 1981 and price level increases for the same period. $ALPHAR_{ij}$ and $ALPHAE_{ij}$ were then calculated using the following equations:

$$ALPHAR_{ij} = \ln \frac{P_{Rij}}{P_{Lij}} - b(\overline{RMC}_{ij} + \overline{BONUS}_{ij})$$

$$ALPHAE_{ij} = \ln \frac{P_{Eij}}{P_{Lij}} - b(\overline{RMC}ij)$$

These equations are transformations of the simplified three-choice model equations.

Base reenlistment and extension rates P_{Rij} and P_{Eij} were calculated by comparing EAOS dates on the June 1980 EMR with those on the September 1981 tape. Changes in EAOS of 36 or more months were considered to be reenlistments, while those between 12 and 35 months were counted as long-term extensions. Each rating's overall base rate was adjusted by the average differential between overall rates and rates for a particular quality type to attain quality-specific estimates. Table E-1 shows relevant statistics on the probability of reenlisting or extending in a rating for each quality type given 1981 bonus multiple levels.

TABLE E-1

REENLISTMENT BEHAVIOR

	Quality type 1	Quality type 2	Quality type 3	Quality type 4
Reenlistment rate				
Mean	.19	.25	.22	.27
Standard deviation	.01	.02	.02	.03
High value	.50	.76	.66	.86
Low value	.02	.03	.02	.03
Extension rate				
Mean	.10	.10	.12	.11
Standard deviation	.01	.01	.01	.01
High value	.39	.36	.45	.41
Low value	.00	.00	.00	.00

ADDITIONAL DATA USED

Base pay and Regular Military Compensation (RMC) were calculated using pay tables supplied by the Deputy Assistant Secretary of Defense for Military Personnel Policy (DASD(MPP)), the EMR for September 1979, and 1981 bonus multiples provided by Op-01. The pay tables give base pay and RMC by length of service and paygrade. The EMR was used to determine the distribution by paygrade for individuals in their fourth year of service. Significant differences in paygrade distribution existed across quality types, but not across rating groups.

Average base pay and RMC values were determined for each quality type by weighting pay tables by the actual distribution of individuals across paygrades. Monthly base pay varies from $734 to $711 depending on quality type, while annual RMC ranges from $13,196 to $12,819. Bonus payments are found by multiplying monthly pay by 4 times the current bonus multiple. Annualized values were calculated based on a 10 percent discount rate.

APPENDIX F

GENDET TO A-SCHOOL FLOWS

APPENDIX F

GENDET TO A-SCHOOL

The flow of GENDETs qualifying for ratings was examined using regression analysis. Initially, EMRs were searched to find the number of GENDETs qualifying for each rating across the first 3 years of service. However, the total number of GENDETs qualifying was small, resulting in very small sample sizes when divided by length of service, rating, and quality type. Probabilities based on these numbers were felt to be too unreliable.

A logit equation of the form $\ln\left(\frac{P}{1-P}\right) = \beta X + e$ was estimated with grouped data using weighted least squares. The equation relates the probability of a GENDET's qualification for a rating to dummy variables representing length of service, rating, quality type, and the interaction of quality type and the technical difficulty of the rating. The base case, corresponding to the omitted dummy variables, represents the probability of a GENDET of quality type 4 being assigned to HT a non-technical rating during the third year of service. Table F-1 shows the estimated coefficients and their associated t-statistics.

The estimates of the probability of becoming rated were derived using the coefficients from the logit equation. Probabilities were normalized so that the total probability of qualifying for a rating in any given year by quality type matched the actual percentage that qualified in FY 1979.

TABLE F-1

REGRESSION RESULTS WHERE DEPENDENT VARIABLE IS
GENDET ASSIGNMENT TO RATING

	Estimated coefficient	t-statistic
Weight	-4.304	-32.72
Length of service one	-1.437	-16.93
Length of service two	-0.481	-9.89
MR	-1.509	-5.72
IM, ML, OM, PM	-2.781	-6.08
DT. HM	-0.953	-4.01
AK, DK, MS, SH, SK	1.223	9.50
EM, IC	0.260	1.44
BT, EN, GS	0.748	5.46
MM	0.327	1.85
ET	-2.402	-5.50
FT	-3.122	-5.79
AD, AM, AS	0.598	3.45
AC, AW	-1.816	-5.19
AE, AQ, AT, AX, TD	-0.498	-1.54
AO	-1.092	-4.64
AB, PR	-0.303	2.03
BU, CE, CM, EA, EO, SW, UT	-3.807	-1.82
AG, AZ, PC, PN, YN	0.448	3.09
OS, QM	-0.581	-2.81
DP	-1.508	-5.71
BM, SM	-.586	12.69
RM	-0.926	-3.96
OT	-3.741	-3.37
ST	-2.392	-5.22
GM, TM	-0.331	-1.70
MN	-2.367	-1.28
CT, IS	-0.529	-1.84
DM, JO, LI, MU, PH	-1.104	-4.74
Quality type 1	0.148	1.41
Quality type 2	0.443	5.23
Quality type 3	-0.185	-1.66
Interaction of quality 1 and technical rating	1.628	4.74
Interaction of quality 2 and technical rating	0.127	0.36
Interaction of quality 3 and technical rating	1.043	2.76
Interaction of quality 1 and semi-technical rating	0.697	4.39
Interaction of quality 2 and semi-technical rating	0.132	0.96
Interaction of quality 3 and semi-technical rating	0.383	2.23

APPENDIX G

ALTERNATIVE BONUS POLICIES

TABLE G-1

OPTIMAL AND ACTUAL POLICIES FOR MEETING CURRENT FORCE REQUIREMENTS

	(1) 1981 Actual Bonus Level	(2) Average Bonus Levels 1974-82	(3) Optimal Bonus Levels for Current Force	(4) Constrained Optimal Bonus Levels for Current Force
Technical Rating Groups				
1. ET	6.0	3.8	9	6
2. FT	5.0	4.0	17	6
3. AE, AQ, AT, AX, TD	1.4	1.8	11	3
4. ST	3.3	4.1	19	5
Median	3.2	3.9	14	5
Mean	3.1	3.4	14	5.5
Semi-Technical Rating Groups				
5. EM, IC	2.7	2.9	10	4
6. IM, MK, OM, DM	0.6	1.2	15	2
7. DT, HM	0.0	1.1	9	1
8. MR	0.0	1.6	13	2
9. MM	6.0	5.5	11	6
10. AD, AS, AM	0.0	.9	5	2
11. AC, AW	4.4	3.9	8	6
12. AO	0.0	1.1	6	2
13. BU, CE, CM, EA, EO, SW, UT	1.2	.7	6	2
14. OS, QM	3.9	3.8	8	5
15. DP	0.0	.5	0	0
16. RM	0.0	1.0	9	2
17. OT	0.0	2.2	8	4
18. GM, TM	2.0	3.1	10	4
19. MN	0.0	.9	0	0
20. CT, IS	0.7	1.6	7	3
21. DM, JO, LI, MU, PH	0.0	.2	4	5
Median	0.0	1.2	8	2.9
Mean	1.2	1.8	7.6	2

TABLE G-2 (Cont'd)

	Optimal multiples for the objective force	Constrained so that maximum multiple = 6	Constrained so that maximum multiple = 8
Non-Technical Rating Groups			
26. AG, AZ, PC, PN, YN	2	2	2
27. BM, SM	4	4	4
Mean	7.1	4.7	5.3
Median	5	5	5

APPENDIX H

DATA AND PROGRAM FOR THE SIMULATION MODEL

```
100 $RESET FREE
200 FILE  1(KIND=DISK,TITLE='STAYER',FILETYPE=8)
300 FILE  2(KIND=DISK,TITLE='ASCHS',FILETYPE=8)
400 FILE  4(KIND=DISK,TITLE='REQ/QUAL',FILETYPE=8)
500 FILE  10(KIND=DISK,TITLE='DAYS',FILETYPE=8)
600 FILE  7(KIND=DISK,TITLE='ASCH',FILETYPE=8)
700 FILE  8(KIND=DISK,TITLE='GENTOA/1',FILETYPE=8)
800 FILE  9(KIND=DISK,TITLE='BETA/1',FILETYPE=8)
900 FILE  6(KIND=REMOTE,TITLE='D4A',MAXRECSIZE=132)
1000 FILE  11(KIND=DISK,TITLE='ALPHAE/QUAL/1',FILETYPE=8)
1100 FILE  12(KIND=DISK,TITLE='ALPHAR/QUAL/1',FILETYPE=8)
1200 FILE  13(KIND=DISK,TITLE='SEXTE/QUAL',FILETYPE=8)
1300 FILE  14(KIND=DISK,TITLE='BMULT/CUR',FILETYPE=8)
1400 FILE  15(KIND=DISK,TITLE='(EJBALIS)APL1',FILETYPE=8)
1500 FILE  16(KIND=DISK,TITLE='(EJBALIS)APL2',FILETYPE=8)
1600 FILE  17(KIND=DISK,TITLE='(EJBALIS)APL3',FILETYPE=8)
1700 FILE  18(KIND=DISK,TITLE='(EJBALIS)APL4',FILETYPE=8)
1750 FILE  19(KIND=DISK,TITLE='REQ5',FILETYPE=8)
1800        DIMENSION    TERMS(3,4),RTC$(4),RTCS(4)
1900        DIMENSION    BON$(28),TRELIG(28)
2000        DIMENSION    GENCON(3,4),ASCHS(4,28),STAYER(27)
2100        DIMENSION    GRADS(8,28),REQ4(28),REQ5(4,28)
2200        DIMENSION    PIJ(4,28),DAYS(28),ASCH$(4,28)
2300        DIMENSION    GENUP(4),GEXTE(4)
2400        DIMENSION    QCONT(4,28),RELIG(4,28),TREQ(28),TQ(28)
2500        DIMENSION    TSHFL(28),RASCHS(4,28),QP(4,28,28)
2600        DIMENSION    GENTOA(3,4,27),XR(4)
2700        DIMENSION    SOUTR(4),TOGEND(4,27),OUTR(4,27)
2800        DIMENSION    P(4,28),Q(5,4,28),ELIG(4,2)
2900        DIMENSION    E(4,27),ALPHAE(4,27),BETA(27)
3000        DIMENSION    ALPHAR(4,27),BMULT(27)
3100        DIMENSION    REUP(4,27),R(4,27),D(4,27)
3200        DIMENSION    EXTE(4,27),QT(5,28),QT1(28)
3300        DIMENSION    SHFL(4,28),QQ(4,28)
3400        DIMENSION    PERM$(4,4,27),TERM$(4,4),C(5,4,28)
3500        DIMENSION    BONUS(4,27),TCBJ(28),OUTR$(4,27)
3600        DIMENSION    GERM$(4,4),DISCNT(4),AVC(4,27,20),QN(4,27)
3700        DIMENSION    RMC$(4),BASE$(4)
3800        DIMENSION    PROC$(4),TOT(27)
3900        DIMENSION    SEXTE(4,27),GSEXT(4)
4000 C
#
```

```
C       DATA ENTRY AND TRANSFORMATION
C
        DATA RTCS/.93,.87,.85,.82/
        DATA ELIG/.933,.933,.874,.874,.672,.672,.546,.546/
        DATA RTC$/2120.,2187.,2210.,2254./
        DATA GENCON/.63,.54,.45,.75,.62,.45,.70,.64,.53,.72,.68,.56/
        DATA TERMS/.96,.96,.96,.97,.97,.96,.92,.92,.93,.92,.92,.93/
        DATA GERM$/7719.,7822.,8052.,8408.,7697.,7841.,8114.,
     * 8457.,7562.,7705.,7960.,8368.,7563.,7715.,7995.,8343./
        DATA TERM$/7890.,8165.,8808.,9600.,7811.,8117.,8798.,9410.,
     * 7717.,8042.,8656.,9429.,7663.,8031.,8683.,9325./
        DATA GENUP/.076,.046,.050,.040/
        DATA GEXTE/.057,.078,.089,.107/
        DATA GSEXT/2.44,1.29,2.15,1.86/
        DATA DISCNT/.909,.826,.751,.683/
        DATA RMC$/10974.,10751.,10785.,10660/
        DATA BASE$/2444.,2399.,2394.,2367./
        DATA PROC$/90.,90.,250.,250./
        READ(9,405)(BETA(J),J=1,27)
        READ(15,406) ((QP(1,I,J),J=1,28),I=1,28)
        READ(16,406) ((QP(2,I,J),J=1,28),I=1,28)
        READ(17,406) ((QP(3,I,J),J=1,28),I=1,28)
        READ(18,406) ((QP(4,I,J),J=1,28),I=1,28)
  406   FORMAT(30F10.6)
  405   FORMAT(1X,F7.6)
        READ(11,415) ((ALPHAE(I,J),I=1,4),J=1,27)
        READ(12,415) ((ALPHAR(I,J),I=1,4),J=1,27)
  415   FORMAT(1X,4F7.3)
        READ(2,400)((GRADS(I,J),I=1,8),J=1,28)
        DO 1 J=1,28
        ASCHS(1,J)=GRADS(5,J)/GRADS(1,J)
        ASCHS(2,J)=GRADS(6,J)/GRADS(2,J)
        ASCHS(3,J)=GRADS(7,J)/GRADS(3,J)
    1   ASCHS(4,J)=GRADS(8,J)/GRADS(4,J)
        READ(1,410) (STAYER(I),I=1,27)
        READ(4,430) ((REQ5(I,J),I=1,4),J=1,28)
        READ(13,421)((SEXTE(I,J),I=1,4),J=1,27)
  421   FORMAT(1X,4F6.3)
         READ(14,422)(BMULT(J),J=1,27)
  422   FORMAT(1X,I2)
        READ(10,450) (DAYS(J),J=1,28)
        READ(7,460) ((ASCH$(I,J),J=1,28),I=1,4)
        READ(8,470) (((GENTOA(K,I,J),J=1,27),I=1,4),K=1,3)
   400  FORMAT(8I4)
   410  FORMAT(5(5F5.2,/),4F5.2)
   420  FORMAT((5F7.0))
   430  FORMAT((4F8.0))
   440  FORMAT((5F6.0))
   450  FORMAT((5I4))
   460  FORMAT((5F7.0))
   470  FORMAT((5(5F6.4,/),4F6.4))
       NRATE=30
       NQUAL=4
       IRATE=NRATE-1.
C
C
#
```

```
C          ANNUALIZATION AND INFLATION ADJUSTMENT OF RMC AND BASEPAY
C
C
             DO 448 I=1,4
             RMC$(I)=RMC$(I)*1.057*.925
             BASE$(I)=BASE$(I)/3.3*.925
  448        CONTINUE
C
C
C              CALCULATE RECRUITS AND ASSIGNMENTS GIVEN BMULTS
C
C
             DO 423 J=1,IRATE
             DO 423 I=1,4
             E(I,J)=EXP(ALPHAE(I,J)+BETA(J)*RMC$(I))
             R(I,J)=EXP(ALPHAR(I,J)+BETA(J)*(RMC$(I)+
     *       BMULT(J)*BASE$(I)))
             D(I,J)=1+E(I,J)+R(I,J)
             REUP(I,J)=R(I,J)/D(I,J)
             EXTE(I,J)=E(I,J)/D(I,J)
             QCONT(I,J)=REUP(I,J)+EXTE(I,J)*(1+SEXTE(I,J)*
     *       (REUP(I,J)+EXTE(I,J)))
             RELIG(I,J)=REQ5(I,J)/QCONT(I,J)
  423        CONTINUE
             DO 768 I=1,4
             RELIG(I,NRATE)=REQ5(I,NRATE)/(GENUP(I)+
     *       GEXTE(I)*(1+GSEXT(I)*(GENUP(I)+GEXTE(I))))
  768        CONTINUE
            DO 444 I=1,4
            DO 444 J=1,28
            DO 444 K=1,28
  444       RASCHS(I,J)=QP(I,J,K)*RELIG(I,K)+RASCHS(I,J)
            DO 445 I=1,4
            DO 445 J=1,28
            IF(RASCHS(I,J).GT.0.0) GO TO 445
            RASCHS(I,J)=0.0
  446       FORMAT(' RASCHS(I,J)=',F10.2,3X,'I=',I4,'J=',I4)
  445       CONTINUE
            DO 447 I=1,4
            DO 447 J=1,28
  447       XR(I)=XR(I)+RASCHS(I,J)/RTCS(I)
            DO 449 I=1,4
            DO 449 J=1,28
            P(I,J)=RASCHS(I,J)/(XR(I)*RTCS(I))
  449       CONTINUE
```

```
C
C     CALCULATION OF PERSONNEL FLOWS
C
C      A SCHOOL FAILURES TO GENDET
       DO 10 I=1,NQUAL
       SOUTR(I)=0.
       DO 5 J=1,IRATE
       TOGEND(I,J)=(1.-ASCHS(I,J))*STAYER(J)
       OUTR(I,J)=XR(I)*RTCS(I)*P(I,J)*TOGEND(I,J)
    5  SOUTR(I)=SOUTR(I)+OUTR(I,J)
C
C      GENDET INVENTORIES LOS1 THRU LOS4 BY QUALITY
C
       Q(1,I,NRATE)=XR(I)*RTCS(I)*P(I,NRATE)*ASCHS(I,NRATE)+SOUTR(I)
       Q(2,I,NRATE)=Q(1,I,NRATE)*GENCON(1,I)
       Q(3,I,NRATE)=Q(2,I,NRATE)*GENCON(2,I)
       Q(4,I,NRATE)=Q(3,I,NRATE)*GENCON(3,I)
   10  CONTINUE
C
C
C      RATING INVENTORIES LOS1 THRU LOS4 BY QUALITY
C
       DO 20 J=1,IRATE
       DO 20 I=1,NQUAL
       Q(1,I,J)=XR(I)*RTCS(I)*P(I,J)*ASCHS(I,J)
       Q(2,I,J)=Q(1,I,J)*TERMS(1,I)+Q(1,I,NRATE)*GENTOA(1,I,J)
       Q(3,I,J)=Q(2,I,J)*TERMS(2,I)+Q(2,I,NRATE)*GENTOA(2,I,J)
       Q(4,I,J)=Q(3,I,J)*TERMS(3,I)+Q(3,I,NRATE)*GENTOA(3,I,J)
   20  CONTINUE
C
C
C       GENDET INVENTORY AT LOS5 BY QUALITY
C
C
        DO 23 I=1,NQUAL
    23  Q(5,I,NRATE)=Q(4,I,NRATE)*ELIG(I,2)*(GENUP(I)+GEXTE(I)
     *  *(1+GSEXT(I)*(GENUP(I)+GEXTE(I))))
C
C       RATING INVENTORY AT LOS5 BY QUALITY
        DO 25 J=1,IRATE
        DO 25 I=1,NQUAL
        E(I,J)=EXP(ALPHAE(I,J)+BETA(J)*RMC$(I))
        R(I,J)=EXP(ALPHAR(I,J)+BETA(J)*(RMC$(I)+BMULT(J)*
     *  BASE$(I)))
        D(I,J)=1+E(I,J)+R(I,J)
        REUP(I,J)=R(I,J)/D(I,J)
        EXTE(I,J)=E(I,J)/D(I,J)
        Q(5,I,J)=Q(4,I,J)*ELIG(I,1)*(REUP(I,J)+
     *  EXTE(I,J)*(1+SEXTE(I,J)*(REUP(I,J)+EXTE(I,J))))
    25  CONTINUE
```

```
C
C
C     CALCULATION OF COSTS
C
C       RECRUITING COSTS
C
        XT=XR(1)+XR(2)
        CT=EXP((XT/32611.4)+9.59)
        TREC$=(2426.5*CT)+XT*90.+250*(XR(3)+XR(4))-35400000.
C
C       RECRUIT TRAINING COSTS
C
        DO 70 I=1,NQUAL
   70   TRTC$=TRTC$+RTC$(I)*XR(I)*RTCS(I)
C
C        A-SCHOOL COSTS
C
          DO 80 I=1,NQUAL
          TASCH$=TASCH$+ASCH$(I,NRATE)*Q(1,I,NRATE)
          DO 80 J=1,IRATE
          TASCH$=TASCH$+ASCH$(I,J)*(Q(1,I,J)+Q(1,I,NRATE)*
     *    GENTOA(1,I,J)*DISCNT(1)+Q(2,I,NRATE)*GENTOA(2,I,J)*
     *    DISCNT(2)+Q(3,I,NRATE)*GENTOA(3,I,J)*DISCNT(3))
   80     CONTINUE
C
       DO 76 I=1,NQUAL
       ASC1=ASC1+ASCH$(I,NRATE)*Q(1,I,NRATE)
       DO 76 J=1,IRATE
       ASC1=ASC1+ASCH$(I,J)*Q(1,I,J)
       ASC2=ASC2+ASCH$(I,J)*Q(1,I,NRATE)*GENTOA(1,I,J)*DISCNT(1)
       ASC3=ASC3+ASCH$(I,J)*Q(2,I,NRATE)*GENTOA(2,I,J)*DISCNT(2)
       ASC4=ASC4+ASCH$(I,J)*Q(3,I,NRATE)*GENTOA(3,I,J)*DISCNT(3)
   76  CONTINUE
C
C         BONUS COSTS
C
       DO 100 J=1,IRATE
       DO 100 I=1,NQUAL
       TBON$=TBON$+Q(4,I,J)*ELIG(I,1)*REUP(I,J)*(1.+
     *EXTE(I,J)*SEXTE(I,J))*(3.3*BMULT(J)*BASE$(I)*DISCNT(4))
  100  CONTINUE
C
C
C       AGGREGATE COSTS
C
C
        AGCOST=TREC$+TRTC$+TASCH$+TBON$
C
```

```
      WRITE(6,313)
  313 FORMAT(19H NUMBER OF RECRUITS)
      WRITE(6,314)
  314 FORMAT(15X,2HQ1,20X,2HQ2,20X,2HQ3,20X,2HQ4)
      WRITE(6,312) (XR(I),I=1,NQUAL)
  312 FORMAT(4F21.1)
      WRITE(6,311)
  311 FORMAT(26H PROBABILITY OF ASSIGNMENT)
      WRITE(6,321)
  321 FORMAT(7H RATING,20X,2HQ1,20X,2HQ2,20X,2HQ3,20X,2HQ4)
      WRITE(6,322)(J,P(1,J),P(2,J),P(3,J),P(4,J),J=1,NRATE)
  322 FORMAT(3X,I4,4F22.2)
      WRITE(6,401) (J,BMULT(J),J=1,IRATE)
 401  FORMAT(3X,'RATING=',I4,'BMULT=',F5.2)
      WRITE(6,320)
 320  FORMAT(' CONTINUATION RATES FROM LOS4-LOS5')
      WRITE(6,111) (J,QCONT(1,J),QCONT(2,J),QCONT(3,J),
     * QCONT(4,J),J=1,IRATE)
 111  FORMAT(3X,I4,4F14.4)
C
C
      WRITE(6,431)
 431  FORMAT(' REENLISTMENT RATES')
      WRITE(6,432)
 432  FORMAT(7H RATING,20X,2HQ1,20X,2HQ2,20X,2HQ3,20X,2HQ4)
      WRITE(6,436)(J,REUP(1,J),REUP(2,J),REUP(3,J),
     *REUP(4,J),J=1,IRATE)
 436  FORMAT(3X,I4,4F20.4)
      WRITE(6,433)
 433  FORMAT(' EXTENSION RATES')
      WRITE(6,432)
      WRITE(6,436)(J,EXTE(1,J),EXTE(2,J),EXTE(3,J),EXTE(4,J),
     *J=1,IRATE)
      WRITE(6,346)AGCOST
 346  FORMAT(' TOTAL COSTS=',F20.2)
      WRITE(6,347)TREC$
 347  FORMAT(' TOTAL RECRUITING COSTS=',F20.2)
      WRITE(6,348)TRTC$
 348  FORMAT(' TOTAL RECRUIT TRAINING COSTS=',F20.2)
      WRITE(6,349)TASCH$
 349  FORMAT(' TOTAL A-SCHOOL COSTS=',F20.2)
      WRITE(6,387)ASC1
 387  FORMAT(F20.2)
      WRITE(6,387)ASC2
      WRITE(6,387)ASC3
      WRITE(6,387)ASC4
      WRITE(6,345)TBON$
 345  FORMAT(' TOTAL BONUS COSTS=',F20.2)
      STOP
      END
#
```

RATING	FAILURES REASSIGNED AS GENDETS	DAYS IN A-SCHOOL TRAINING	BETA FOR ACOL MODEL EQUATIONS
1	0.93	205	.000257
2	0.89	136	.000257
3	0.93	151	.000252
4	0.90	400	.000193
5	0.92	113	.000187
6	0.94	106	.000218
7	0.97	71	.000289
8	1.00	70	.000218
9	0.88	60	.000187
10	0.89	65	.000252
11	0.86	93	.000193
12	0.92	78	.000250
13	0.87	69	.000314
14	0.99	40	.000193
15	0.92	56	.000263
16	0.92	70	.000193
17	0.91	77	.000193
18	0.92	294	.000132
19	0.70	112	.000132
20	0.98	178	.000311
21	0.98	108	.000187
22	0.93	80	.000218
23	0.91	49	.000354
24	0.86	62	.000187
25	0.98	48	.000257
26	0.95	60	.000275
27	0.96	42	.000235
28	----	28	-------

A-SCHOOL TRAINING COSTS

RATING	Q1	Q2	Q3	Q4
1	8422.	8843.	10302.	12105.
2	5143.	5831.	5621.	5464.
3	7976.	8518.	9771.	10022.
4	10909.	10909.	11018.	10909.
5	5519.	6125.	6812.	7099.
6	8116.	7915.	9110.	9612.
7	4567.	4618.	4977.	5345.
8	4061.	4432.	5228.	5218.
9	4575.	4311.	5188.	5754.
10	2937.	3010.	3076.	3197.
11	6847.	7359.	7710.	7639.
12	3570.	3740.	4004.	4024.
13	4223.	4232.	4329.	4329.
14	1892.	1986.	1993.	2103.
15	3799.	3879.	4008.	3925.
16	5089.	5124.	5618.	5826.
17	10780.	12690.	11899.	20786.
18	5317.	5542.	5970.	7379.
19	9487.	10155.	10707.	11824.
20	11730.	12114.	13553.	15232.
21	6602.	6771.	7297.	7838.
22	5532.	5516.	5876.	6298.
23	2433.	2428.	2501.	2501.
24	5817.	5939.	6409.	6714.
25	3614.	3654.	3690.	3727.
26	3113.	3258.	3290.	3581.
27	2172.	2263.	2289.	2294.
28	1042.	1042.	1042.	1042.

A-SCHOOL SURVIVAL RATES

RATING	Q1	Q2	Q3	Q4
1	0.430	0.350	0.210	0.080
2	0.760	0.629	0.572	0.667
3	0.650	0.590	0.440	0.375
4	0.860	0.818	0.671	0.867
5	0.880	0.660	0.510	0.441
6	0.958	0.935	0.839	0.750
7	0.910	0.780	0.700	0.570
8	0.900	0.759	0.579	0.581
9	0.960	0.840	0.740	0.651
10	0.930	0.900	0.840	0.769
11	0.720	0.773	0.590	0.632
12	0.988	0.979	0.904	0.873
13	0.950	0.930	0.910	0.908
14	0.960	0.879	0.890	0.794
15	0.951	0.909	0.855	0.839
16	0.900	0.889	0.711	0.571
17	0.851	0.636	0.711	0.308
18	0.810	0.691	0.560	0.400
19	1.000	0.875	0.793	0.667
20	0.780	0.700	0.610	0.600
21	0.910	0.893	0.692	0.333
22	0.940	0.949	0.869	0.781
23	0.970	0.980	0.930	0.930
24	0.910	0.880	0.760	0.720
25	0.981	0.909	0.941	0.932
26	0.960	0.870	0.869	0.760
27	0.971	0.890	0.871	0.868
28	1.000	1.000	1.000	1.000

ALPHA FOR ACOL MODEL LONG TERM EXTENSION EQUATION

RATING	Q1	Q2	Q3	Q4
1	-5.850	-5.748	-5.557	-5.545
2	-6.396	-6.361	-6.146	-6.134
3	-5.368	-5.294	-5.085	-5.095
4	-5.620	-5.605	-5.387	-5.436
5	-6.209	-6.169	-5.962	-5.991
6	-5.313	-5.290	-5.068	-5.113
7	-5.319	-5.257	-5.033	-5.057
8	-5.364	-5.351	-5.127	-5.179
9	-6.250	-6.147	-5.967	-5.949
10	-4.730	-4.660	-4.435	-4.452
11	-5.360	-5.185	-5.028	-4.953
12	-4.703	-4.645	-4.416	-4.443
13	-5.316	-5.206	-4.987	-4.979
14	-6.239	-6.122	-5.947	-5.919
15	-3.657	-3.465	-3.206	-3.143
16	-4.424	-4.378	-4.156	-4.137
17	-3.106	-3.053	-2.770	-2.813
18	-4.723	-4.655	-4.458	-4.465
19	-1.522	-1.367	-0.962	-0.953
20	-4.584	-4.447	-4.189	-4.165
21	-2.853	-2.815	-2.484	-2.548
22	-6.157	-6.131	-5.917	-5.958
23	-6.004	-5.863	-5.658	-5.625
24	-5.525	-5.459	-5.259	-5.270
25	-4.332	-4.272	-4.020	-4.032
26	-4.587	-4.419	-4.213	-4.155
27	-4.614	-4.569	-4.341	-4.375

ALPHA FOR ACOL MODEL REENLISTMENT EQUATION

RATING	Q1	Q2	Q3	Q4
1	-4.990	-4.551	-4.676	-4.401
2	-6.147	-5.778	-5.883	-5.657
3	-4.480	-4.083	-4.193	-3.948
4	-4.645	-4.284	-4.394	-4.171
5	-4.218	-3.852	-3.965	-3.738
6	-4.962	-4.613	-4.713	-4.501
7	-4.851	-4.472	-4.567	-4.339
8	-5.159	-4.828	-4.923	-4.724
9	-3.815	-3.380	-3.518	-3.239
10	-4.174	-3.785	-3.880	-3.645
11	-3.250	-2.746	-2.906	-2.574
12	-4.327	-3.952	-4.042	-3.817
13	-4.851	-4.417	-4.518	-4.253
14	-3.810	-3.361	-3.503	-3.214
15	-3.295	-2.786	-2.846	-2.531
16	-3.737	-3.373	-3.471	-3.249
17	-3.449	-3.079	-3.115	-2.907
18	-3.002	-2.606	-2.732	-2.479
19	-1.809	-1.337	-1.251	-0.990
20	-4.438	-3.981	-4.042	-3.765
21	-3.666	-3.311	-3.299	-3.111
22	-4.785	-4.438	-4.543	-4.331
23	-5.162	-4.699	-4.813	-4.525
24	-3.944	-3.550	-3.668	-3.422
25	-4.411	-4.032	-4.099	-3.378
26	-3.806	-3.320	-3.434	-3.124
27	-4.191	-3.828	-3.920	-3.701

GENDET ASSIGNMENT TO RATINGS: YEAR TWO

RATING	Q1	Q2	Q3	Q4
1	0.0055	0.0024	0.0007	0.0006
2	0.0027	0.0012	0.0003	0.0000
3	0.0359	0.0160	0.0046	0.0038
4	0.0055	0.0024	0.0007	0.0006
5	0.0174	0.0239	0.0127	0.0083
6	0.0008	0.0012	0.0006	0.0004
7	0.0052	0.0073	0.0038	0.0025
8	0.0030	0.0041	0.0022	0.0015
9	0.0185	0.0255	0.0135	0.0088
10	0.0242	0.0331	0.0177	0.0115
11	0.0022	0.0030	0.0016	0.0010
12	0.0045	0.0063	0.0033	0.0022
13	0.0004	0.0002	0.0001	0.0004
14	0.0075	0.0105	0.0054	0.0035
15	0.0030	0.0041	0.0000	0.0000
16	0.0053	0.0074	0.0039	0.0025
17	0.0003	0.0004	0.0000	0.0000
18	0.0096	0.0135	0.0071	0.0046
19	0.0013	0.0017	0.0000	0.0000
20	0.0079	0.0111	0.0058	0.0037
21	0.0045	0.0063	0.0000	0.0000
22	0.0113	0.0094	0.0068	0.0063
23	0.0391	0.0308	0.0224	0.0212
24	0.0247	0.0195	0.0141	0.0134
25	0.0160	0.0126	0.0091	0.0086
26	0.0184	0.0146	0.0105	0.0100
27	0.0558	0.0438	0.0321	0.0303

GENDET ASSIGNMENT TO RATINGS: YEAR THREE

RATING	Q1	Q2	Q3	Q4
1	0.0073	0.0037	0.0008	0.0012
2	0.0035	0.0018	0.0004	0.0000
3	0.0468	0.0241	0.0050	0.0084
4	0.0074	0.0037	0.0008	0.0012
5	0.0228	0.0357	0.0135	0.0179
6	0.0011	0.0018	0.0006	0.0008
7	0.0069	0.0110	0.0041	0.0054
8	0.0039	0.0064	0.0024	0.0031
9	0.0243	0.0381	0.0144	0.0190
10	0.0317	0.0491	0.0187	0.0247
11	0.0029	0.0048	0.0017	0.0023
12	0.0060	0.0097	0.0035	0.0047
13	0.0004	0.0006	0.0002	0.0003
14	0.0099	0.0159	0.0059	0.0078
15	0.0039	0.0064	0.0000	0.0000
16	0.0071	0.0113	0.0042	0.0055
17	0.0004	0.0007	0.0000	0.0000
18	0.0127	0.0202	0.0075	0.0099
19	0.0017	0.0027	0.0000	0.0000
20	0.0105	0.0167	0.0062	0.0082
21	0.0060	0.0096	0.0000	0.0000
22	0.0156	0.0142	0.0072	0.0138
23	0.0509	0.0458	0.0235	0.0453
24	0.0324	0.0293	0.0149	0.0287
25	0.0209	0.0191	0.0096	0.0186
26	0.0242	0.0220	0.0112	0.0215
27	0.0720	0.0644	0.0335	0.0643

QUALITY	RECRUIT TRAINING SURVIVAL	SURVIVAL IN RATING YEAR ONE	SURVIVAL IN RATING YEAR TWO	SURVIVAL IN RATING YEAR THREE	REENLISTMENT ELIGIBILITY IN RATINGS
1	0.93	0.96	0.96	0.96	0.933
2	0.87	0.97	0.97	0.97	0.933
3	0.85	0.92	0.92	0.93	0.874
4	0.82	0.92	0.92	0.93	0.874

QUALITY	SURVIVAL AS GENDET YEAR ONE	SURVIVAL AS GENDET YEAR TWO	SURVIVAL AS GENDET YEAR THREE	REENLISTMENT ELIGIBILITY AS GENDET
1	0.63	0.54	0.45	0.672
2	0.75	0.62	0.45	0.672
3	0.70	0.64	0.53	0.546
4	0.72	0.68	0.56	0.546

GENDET REENLISTMENT BEHAVIOR

QUALITY	REENLISTMENT RATE	EXTENSION RATE	RATIO OF SHORT-TERM TO LONG-TERM EXTENSIONS
1	0.076	0.057	2.440
2	0.046	0.078	1.290
3	0.089	0.089	2.150
4	0.040	0.107	1.860

QUALITY	AFEES PROCESSING COSTS	RECRUIT TRAINING COSTS	ANNUAL RMC IN LOS-4	FOUR MONTHS BASE PAY IN LOS-4
1	90.	2120.	10151.	2261.
2	90.	2187.	9945.	2219.
3	250.	2210.	9976.	2214.
4	250.	2254.	9861.	2189.